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FBIS Report —

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Central Eurasia

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Science & Technology

Central Eurasia

FBIS-UST-95-039

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28 September 1995

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**Combination Light Scattering and
Photoluminescence of Porous Silicon**

957A0987A St. Petersburg FIZIKA I TEKHNIKA
POLUPROVODNIKOV in Russian Apr 95 No 4,
(manuscript received 31 May 93; signed to press 2 Sep
94) pp 582-589

[Article by V. A. Karavanskiy, A. N. Obraztsov, Institute of General Physics, Russian Academy of Sciences Scientific Research Institute of Nuclear Physics, Lomonosov Moscow State University, Moscow]

[FBIS Abstract] This paper presents the results of studies of the photoluminescence, combination light scattering, and the light reflection spectra of porous silicon samples on silicon substrates with variations in the length and current density of anodizing. Layers of porous silicon were obtained using various electrochemical etching modes. The intensity of photoluminescence increases with anodizing time and current density. It has a tendency toward saturation at large film thicknesses of nanoporous silicon. The shape of the photoluminescence spectrum remains virtually unchanged. There is a non-monotonic dependence of the optical depth of porous silicon film and the intensity of photoluminescence and combination light scattering on the length and current density of anodizing. The strength of the light reflection coefficient signal depends greatly on the film manufacturing method and is not correlated with photoluminescence. The signal is a factor of 2 to 3.5 higher than in monocrystalline silicon. The position and shape of the signal line at a given current density is independent of the anodizing time and remains symmetrical with a maximum shift of less than 1 cm^{-1} . A change in current density (with unchanged anodizing time) leads to qualitative changes in the light reflection signal spectrum. At low current densities the line shape is virtually symmetrical. The position of the maximum does not vary from 8 mA/cm^2 . Figures 6; references 14: 2 Russian, 12 Western.

**Superluminescence Polarization and Anisotropy of
Optical Losses in a InGaP/GaAs/InGaP Waveguide
Structure**

957A0987B St. Petersburg FIZIKA I TEKHNIKA
POLUPROVODNIKOV in Russian Apr 95 No 4,
(manuscript received 6 Apr 94; signed to press 21 Sep
94) pp 590-598

[Article by V. Ya. Aleshkin, S. A. Akhlestina, B. N. Zvonkov, N. B. Zvonkov, Ye. R. Linkova, I. G. Malkina, Yu. N. Safyanov, D. G. Revin; Scientific Research Physicotechnical Institute at Lobachevskiy Nizhegorod State University, Institute of Physics of

Microstructures, Russian Academy of Sciences, Nizhny Novgorod]

[FBIS Abstract] Structure, superluminescence, and stimulated radiation are studied in InGaP/GaAs/InGaAs/GaAs/InGaP laser structures in which InGaP acts as a wide zone material and the active region is the quantum well of InGaAs. Losses in the waveguide in the spectral region near $1 \mu\text{m}$ are strongly dependent on the direction of radiation propagation. Waveguide anisotropy is dependent on the sign of misalignment of the lattices of the solid solution and the substrate. The observed polarization of superluminescence is due to the dependence of radiation scattering on the direction of propagation of the waveguide mode. Superluminescence appears in excitation above 10^4 W/cm^2 , and appears only in structures with InGaP waveguide layers. Superluminescence polarization is dependent on the sign of misalignment of the lattices. The superluminescence of structures with different quantum well widths and misalignments are examined. Figures 4; table 1; references 19: 3 Russian, 16 Western.

**Kinetics and Spectral Distribution of the
Electroluminescence of Porous Silicon-Metal
Structures**

957A0987C St. Petersburg FIZIKA I TEKHNIKA
POLUPROVODNIKOV in Russian Apr 95 No 4,
(manuscript received 12 Sep 94; signed to press 21 Sep
94) pp 627-635

[Article by V. Ya. Averbukh, A. V. Andrianov, Z. V. Belyakov, D. N. Goryachev, D. I. Kovalev, O. M. Sresel, I. D. Yaroshetskiy, Ioffe Physicotechnical Institute, Russian Academy of Sciences, St. Petersburg]

[FBIS Abstract] The spectral and temporal properties of the electroluminescence of light radiating structures based on contact of porous silicon with chemically deposited metal are studied. In the visible there is fast electroluminescence with a characteristic time of less than 10 ns, and in the infrared, slow electroluminescence with a time constant of $4 \mu\text{s}$. The electroluminescence spectrum is shifted toward lower energies relative to the photoluminescence spectrum. The results indicate the participation of recombination through surface states at the metal-porous silicon contact. The results also indicate a nonuniform current distribution over the contact surface. The quantum efficiency of electroluminescence is better than 10^{-6} . The volt-ampere characteristics of structures are studied in steady-state and pulsed modes. The results are explained using a model of a high-ohm thin layer of wide zone semiconductor between two junctions, an external Schottky metal-semiconductor contact, and an internal porous silicon-

crystalline silicon heterojunction. Explanations are offered for high local current densities in the samples. Figures 5; references 11: 4 Russian, 7 Western.

Resonant Raman Light Scattering on Interface Phonons in a GaAs/AlAs Superlattice in a Strong Magnetic Field

957A0987D St. Petersburg FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Apr 95 No 4, (manuscript received 20 Sep 94; signed to press 22 Sep 94) pp 636-645

[Article by D. N. Mirlin, A. A. Sirenko, R. Planel, Ioffe Physicotechnical Institute, Russian Academy of Sciences, St. Petersburg]

[FBIS Abstract] The dependence of resonant Raman scattering on interface and optical phonons in a GaAs/AlAs superlattice on the magnetic field, temperature, and pumping strength are studied. Bands of interface phonons are observed in a strong magnetic field. Scattering on these phonons is forbidden by the law of conservation of momentum. The intensity of interface phonons decreases as temperature increases. At low temperatures, exciton states are localized at static defects near the heteroboundary. These exciton states are intermediate in terms of light scattering on both interface and optical phonons. The defects are islands created by fluctuations in the widths of quantum wells. An increase in localization energy is observed as the magnetic field increases. Figures 6; references 16: 1 Russian, 15 Western.

Optical Absorption Properties of Luminescent Porous Silicon Films

957A0987E St. Petersburg FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Apr 95 No 4, (manuscript received 15 Jun 94; signed to press 3 Oct 94) pp 669-672

[Article by D.G. Yarkin, Ye. A. Konstantinova, V.A. Timoshenko, Lomonosov Moscow State University]

[FBIS Abstract] Photodeflection spectroscopy is used to study the absorption coefficient of luminescent porous silicon films at $h\nu = 0.6-2.0$ eV. The results are explained by contributions of silicon crystallites of different sizes. Defect absorption is studied in the infrared. There is weak absorption (α about 10 cm^{-1}) in the infrared in the initial and laser irradiated samples. Irradiation of porous silicon with light with $h\nu = 2.54$ eV resulted in intense photoluminescence. The spectra of the coefficient of absorption of porous silicon differs significantly from the spectrum of crystalline silicon only at $h\nu > 1.5$ eV, increasing as porosity increases. The spectrum is also very different from the spectrum of amorphous silicon. Absorption in defects may increase

by a factor of 1.2 to 1.3 after laser irradiation. The intensity of photoluminescence then decreases by about a factor of 18. Figures 2; references 6: 1 Russian, 5 Western.

Photodegradation of Porous Silicon in Pulse Excitation

957A0987F St. Petersburg FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Apr 95 No 4, (manuscript received 23 Aug 94; signed to press 3 Oct 94) pp 673-677

[Article by Y. H. Xie, I. N. Germanenko, V. F. Voronin, S. V. Gaponenko; B. I. Stepanov Institute of Physics, Belarus Academy of Sciences, Minsk, AT&T Bell Laboratories, Murray Hill, N.J.]

[FBIS Abstract] One factor hindering the practical use of porous silicon is photodegradation of luminescence. The change in intensity and the photoluminescence spectra of porous silicon are studied when it is subjected to nanosecond ultraviolet radiation pulses. Nanosecond pulses significantly decrease the role of thermal effects in irradiation and may substantially alter the character of degradation processes. As the number of pulses increased, the intensity of luminescence decreased over the entire spectral range. A decrease in the intensity of photoluminescence is accompanied by a shift in the spectrum toward the longwave region. Photodegradation is interpreted as a result of an increase the probability of nonradiative transitions in optical charging of active regions, or as a result of photodestruction of active regions. An increase in the rate of degradation with a decrease in the luminescence wavelength qualitatively agrees with a quantum-dimensional model used to explain the nature of the photoluminescence of porous silicon. The effect of differing sizes of residue silicon crystallites is considered. Figures 2; references 16: 2 Russian, 14 Western.

Type II Heterojunctions in GaInAsSb/InAs

957A0987G St. Petersburg FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Apr 95 No 4, (manuscript received 27 Sep 94; signed to press 3 Oct 94) pp 678-685

[Article by M. P. Mikhaylova, I. A. Andreyev, T. I. Voronina, T. S. Lagunova, K. D. Moiseyev, Yu. P. Yakovlev, Ioffe Physicotechnical Institute, Russian Academy of Sciences, St. Petersburg]

[FBIS Abstract] For the first time heterojunctions based on solid solutions of $\text{Ga}_{1-x}\text{In}_x\text{As}_y\text{Sb}_{1-y}$ ($x = 0.17, y = 0.22$) are obtained and studied. They are isoperiodic with a InAs(100) substrate. The galvanomagnetic, electric, and photoelectric properties of four types of heterostructures

are studied: N-n-, p-p, p-n-, and n-p-GaInAsSb/InAs. The values of potential jumps at the heteroboundary, ΔE_c , ΔE_v , are determined and approximate zone energy diagrams are established for these heterojunctions. The $\text{Ga}_{0.83}\text{In}_{0.17}\text{As}_{0.22}\text{Sb}_{0.78}/\text{InAs}$ heterostructure is a broken-gap type II heterojunction and has close quantum wells for electrons and holes. In narrow zone materials these wells may be rather deep and apparent to T 77K. For the first time high electron mobility is observed ($\mu_n = 70000 \text{ cm}^2/\text{V s}$ at 77 K) in the channel in a single GaInAsSb/InAs heterojunction. The heterojunction was obtained by growing an undoped layer of the four-component solid solution on a slightly doped p-InAs substrate. An external electric field may be used to control zone bending at the heteroboundary and the position of bending, leading to a change in the population density of quantum wells. Figures 5; references 19: 5 Russian, 14 Western.

Observation of the Electroluminescence of Localized Carriers in Single Type-II Broken-Gap p-GaInAsSb/p-InAs Heterojunctions

957A0987H St. Petersburg FIZIKA I TEKHNKA POLUPROVODNIKOV in Russian Apr 95 No 4, (manuscript received 28 Sep 94; signed to press 3 Oct 94) pp 687-696

[Article by M. P. Mikhaylov, G. G. Zegrya, K.D. Moiseyev, I. N. Timchenko, Yu. P. Yakovlev, Ioffe Physicotechnical Institute, Russian Academy of Sciences, St. Petersburg]

[FBIS Abstract] Electroluminescence is observed for the first time in single isotype broken-gap type-II p-GaInAsSb/p-InAs heterojunctions even when an external electric field is applied. The electroluminescence is due to recombination of spatially separated electrons and holes in quantum wells at the heteroboundary. Two narrow luminescence peaks with a half-width of about 10-20 meV are seen at 77 K at 3-5 μm . The spectral position and intensity of the peaks varies as the pump current varies. Intense electroluminescence is observed at room temperature. The intensity of electroluminescence drops by a factor of 25 at 77-300 K. The observed electroluminescence is comparable in intensity with a typical light diode p-n-heterostructure at 3-3.5 μm (InAs/InAsSbP). It is predicted that it is possible to create a new tunable source of infrared radiation which uses an isotype broken-gap p-p type II heterojunction in the active region. Figures 4; references 23: 10 Russian, 13 Western.

Features of the Volt-Ampere Characteristic of an Asymmetrical System of GaAs/AlGaAs Quantum Wells Separated by Wide Barriers

957A0987I St. Petersburg FIZIKA I TEKHNKA POLUPROVODNIKOV in Russian Apr 95 No 4, (manuscript received 6 Apr 94; signed to press 31 Oct 94) pp 720-724

[Article by V. I. Kadushkin, V. V. Kapayev, I. V. Kucherenko, A. I. Podlivayev, I. A. Rudnev, A. A. Sinchenko, Ye. L. Shangina, Scientific Research Technological Institute, Ryazan, Lebedev Physics Institute, Russian Academy of Sciences, Moscow, Moscow Engineering-Physics Institute]

[FBIS Abstract] Differential volt-ampere characteristics are studied for vertical transport in a GaAs/AlGaAs heterosystem with three quantum wells and wide edge barriers. This transport is perpendicular to the heterojunction plane. The characteristics have features associated with resonant tunneling of electrons. Small variations in structure can greatly affect the passage of electrons. The position of quasilevels in the system is independent of barrier thickness. The dependence of quasilevel energy on the external applied voltage is shown in a figure. However, energy levels are not manifested in the photoluminescence spectra for this structure. It is found that the energy spectrum of a structure consisting of three quantum wells may be reestablished from volt-ampere characteristic measurements despite the wide barriers. When asymmetrical quantum wells are linked by tunnels, redilocation of electron states by an external electric and/or magnetic field is possible. A magnetic-field-induced photogalvanic effect has been observed. Figures 4; references 6: 4 Russian, 2 Western.

Acquisition and Study of Porous Silicon in Powder Form

957A0987J St. Petersburg FIZIKA I TEKHNKA POLUPROVODNIKOV in Russian Apr 95 No 4, (manuscript received 2 Nov 94; signed to press 8 Nov 94) pp 733-74

[Article by A. V. Andrianov, L. V. Belyakov, D. N. Goryachev, O. M. Sreseli, I. D. Yaroshetskiy, Ioffe Physicotechnical Institute, Russian Academy of Sciences, St. Petersburg]

[FBIS Abstract] This paper studies the luminescence properties of porous silicon powder obtained using a modification of the electrochemical method (direct formation of porous silicon). The formation of porous silicon and powdered porous silicon is examined. The role of secondary crystallization of silicon in the formation of porous silicon is discussed. This crystallization is associated with a disproportional amount of doubly-ionized silicon atoms. A method of obtaining porous silicon in powdered form is developed and described. The spectral and temporal characteristics of the photoluminescence of the powder and porous silicon films are found to be identical. The visible photoluminescence is due to silicon microcrystals and radiative recombination of quantum-dimensional electrons and holes. Polarization of pump radiation of powders and films is due to quasi-one-dimensional microcrystals. Anisotropy of excitation by linearly polarized light is due to chaotic distribution of microcrystals in the powder or film. Linear polarization of photoluminescence in porous silicon films may be about 10 percent in linearly-polarized light. This substance is a luminophore with memory of the polarization of the excitation radiation. Figures 5; references 13: 5 Russian, 8 Western.

Propagation Dynamics of a Pair of Soliton Pulses in a Fiber Lightguide With Losses

957A1009A St. Petersburg PISMA V ZHURNAL
TEKHNICHESKOY FIZIKI in Russian 12 Apr 95
Vol 21 No 7, (manuscript received 28 Dec 94) pp 6-11

[Article by A. S. Shcherbakov, Ye. I. Andreyeva, St. Petersburg State Technical University]

[FBIS Abstract] Picosecond optical soliton pulses experience blending of successive pulses due to displacement in a one-mode fiber lightguide. The initial parameters and possible propagation lengths must be determined for a sequence of picosecond solitons which remain distinct. This paper obtains approximate equations to analytically calculate the contribution of interaction to the propagation characteristics of pairs of fundamental solitons and pulses with a first-order soliton center in a lightguide with losses when there is a limit on the repeat rate of pulses in the pair. The interaction dynamics of a pair of inphase fundamental solitons of the same amplitude in a lightguide without losses is discussed. The effect of optical losses is then considered. The length of transmission in a lightguide with losses will be maximal at a high repeat rate of interacting fundamental solitons if the shortest pulses with a high initial repeat rate are used. It is found that under the appropriate conditions pulses may propagate over great distances without being distorted by interaction. Figure 1; references 14: 1 Russian, 13 Western.

Surface Acoustic Waves in the Structure of a GaAs Layer of a 2D Electron Gas in a Magnetic Field

957A1009B St. Petersburg PISMA V ZHURNAL
TEKHNICHESKOY FIZIKI in Russian 12 Apr 95
Vol 21 No 7, (manuscript received 25 Nov 94) pp 30-34

[Article by B. D. Zaytsev, I. Ye. Kuznetsova. Saratov branch of the Institute of Radio Engineering and Electronics, Russian Academy of Sciences, Saratov]

[FBIS Abstract] This paper solves the problem of the propagation of a Rayleigh surface acoustic wave in the structure of a conducting layer with an arbitrary conductivity, a GaAs substrate in an external magnetic field. The solution is based on standard equations of motion of an elastic medium, the Poisson equation, the equation of continuity of charge, material equations for mechanical stress, electric induction, and conductivity current with a consideration of the piezoelectric effect and diffusion of the charge carriers. Study of the attenuation (in amplitude) in relation to surface acoustic wavelength shows that the optimum is associated with a dependence of attenuation on surface conductivity. As the unperturbed surface conductivity increases the attenuation peak shifts toward stronger magnetic fields. As bulk conductivity increases, the dependence becomes linear and eventually ceases to depend on the magnetic field. There is a dependence of the relative change in the speed of a surface acoustic wave on the induction of the magnetic field. As the magnetic field increases, the speed of the surface acoustic wave increases and eventually reaches saturation. The maximum change in speed falls as bulk conductivity rises, eventually going to zero. As the magnetic field increases, surface conductivity drops, decreasing the degree of screening of the piezoelectric fields of the surface acoustic wave, leading to an increase in speed. As bulk conductivity increases, full screening is reached and speed ceases to depend on surface conductivity or the magnetic field. Figures 2; references 3 (Russian).

Photosensitivity Spectra of p-i-n Diodes Based on Charged Si-GeSi Superlattices

957A1009C St. Petersburg PISMA V ZHURNAL
TEKHNICHESKOY FIZIKI in Russian 12 Apr 95
Vol 21 No 7, (manuscript received 10 Dec 94) pp 35-39

[Article by Yu. G. Sadofyev, Scientific Research Technological Institute, Ryazan]

[FBIS Abstract] Quantum-dimensional structures based on elementary semiconductors may be used as effective photoreceptors for wavelengths beyond the limits of ground-state absorption of silicon. An increase in photosensitivity near the "red" limit of ground-state

silicon absorption bands is also attractive. Molecular beam epitaxy was used to synthesize charged $\text{Si-Ge}_x\text{Si}_{1-x}$ superlattices on silicon with (100) and (111) orientations. X-ray diffraction from the superlattice showed that the results agreed well with theoretical results, indicating high-quality superlattice layers and heteroboundaries. Mesa diodes with a mesa diameter of 0.5 mm were manufactured with a ring electrode at the periphery and solid metallization of the rear side of the substrate. A figure shows the dependence of photosensitivity on the proportion of Ge in GeSi layers of the superlattice. The "red" limit of photosensitivity shifts toward longer wavelengths as the proportion of Ge increases in solid solution layers. At $x = 0.4$ the maximum photoresponse is observed at 1.04-1.06 μm . The threshold of sensitivity is at 1.4 μm . At the absorption band maximum the A-W sensitivity reaches 0.6-0.75 A/w, which is close to the theoretical value for these wavelengths. It is believed that internal amplification of the photocurrent in the diode is at work. In p-i-n diodes based on charged superlattices of Si-GeSi on silicon the photosensitivity spectrum is shifted toward the infrared compared with silicon devices, yet they retain high levels of photosensitivity. The devices can be improved by decreasing the level of uncontrolled doping and structural defects. Figures 3; references 6: 1 Russian, 5 Western.

Mechanical Properties and Structure of High-Temperature Superconducting YBCO/Cu²O Composites

957A1010A St. Petersburg PISMA V ZHURNAL
TEKHNICHESKOY FIZIKI in Russian 26 Apr 95
Vol 21 No 8, (manuscript received 5 Dec 94) pp 7-11

[Article by Ye. M. Gololobov, A. S. Masakovskaya, N. V. Belyayeva, N. Ye. Strelyukhina, Institute of the Solid-State Physics of Semiconductors, Academy of Sciences of Belarus]

[FBIS Abstract] High-temperature superconducting ceramics are brittle materials. Their mechanical properties are usually studied with microindentation tests. Durability and plasticity are studied with microhardness tests. It had been found that the addition of about 2.5 percent by mass of copper powder irradiated with the γ quanta of ^{60}Co or an oxide made of this powder improved the superconducting properties of $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ and increased the microhardness. This paper studies the effect of the addition of copper oxide obtained from this irradiated copper in yttrium-containing ceramic on the mechanical and structural properties of $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ /

Cu^{2+}O . A figure shows the dependence of microhardness on the concentration of Cu^{2+}O . The first maximum of microhardness is at Cu^{2+}O about 3.5 percent by mass. A second maximum is at about 30 percent by mass. Explanations are offered. Further increases in CuO content do not increase microhardness because CuO is less hard than the composite. The maximum fracture resistance was found in the crystallites of samples with a small Cu^{2+}O content (up to 5 percent by mass). Electron photographs show the structure of the composite for various amounts of Cu^{2+}O . Nonirradiated CuO does not yield changes in texture the way Cu^{2+}O does. Figures 2; references 11: 8 Russian, 3 Western.

Sublimation Epitaxy of 6H- and 4H-SiC on Inch Monocrystalline Substrates of SiC Obtained From Bulk Slabs

957A1010B St. Petersburg PISMA V ZHURNAL
TEKHNICHESKOY FIZIKI in Russian 26 Apr 95
Vol 21 No 8, (manuscript received 20 Dec 94) pp 51-57

[Article by A. Yu. Makhimov, A. A. Maltsev, N. K. Yushin, I. P. Nikitina]

[FBIS Abstract] Practical use of SiC is hindered by structural imperfections (pores, accumulation of dislocations, inclusion of various polytypes), high doping level, and the small dimensions of the initial substrate materials obtained from bulk slabs. This paper studies epitaxial layers obtained with sublimation in vacuum on inch size substrates of polytypes 6H and 4H-SiC cut from bulk slabs. These layers are compared with epitaxial layers grown under the same conditions but on Lilly 6H and 4H-SiC plates no less than 8 x 8 mm in size. The oscillation curves obtained from inch 6H- and 4H-SiC grown using sublimation are a system of broadened peaks with an angular distance between them comparable with the half-widths of the peaks (35-60 arc seconds). The half widths of the oscillation curves of 4H-SiC epitaxial layers grown with sublimation in vacuum on Lilly substrates and inch plates virtually coincide in value and shape despite the substantial differences in the substrates. The oscillation curves of 6H-SiC epitaxial layers grown on inch substrate plates have an asymmetry which may be due to different phases in the epitaxial layer inherited from the substrate. The half-width of the oscillations curve is affected (increased) when the reverse sides of the inch plates are only polished. Substrate structure is discussed. Figures 3; table 1; references 8: 5 Russian, 3 Western.

Technical Safeguarding of Information

957A0972A Moscow VESTNIK SVYAZI in Russian
May 95 No 5, pp 23-24, 26, 28]

[Article by A. V. Petrakov, professor, doctor of technical sciences, department head, Moscow Technical University for Communications and Information; the first paragraph is an introduction]

[FBIS Translated Text] A. V. Petrakov, professor, doctor of technical sciences, has prepared for publication the book "Zashchita i okhrana informatsii, lichnosti, imushchestv..." (Protection and Safeguarding of Information, the Person and Property...), which describes matters related to the protection and safeguarding of information, the individual, residence, office, business, dacha, automobile, etc. by means of modern, world-level instruments, methods and procedures, including on the basis of use of experience of Russian-foreign (such as Knowledge Express) and Russian companies, such as Eleron. The size of the book is 100,000-120,000 typographical units. The book is intended for a wide range

of readers concerned with the criminalization of society and those desiring to ensure safety for themselves and for those close to them against losses, expenditures and looting. Send orders for the book to the editorial offices or order by telephone prior to 1 June 1995

The digital encoding method provides for the preliminary conversion of a vocal continuous signal into a digital (quantized) form. In accordance with the Kotelnikov theorem, any continuous signal can without loss of information be replaced by a successive set of instantaneous values of this signal if these signal values are assigned a frequency not less than twice as great as the highest-frequency component of this signal. In a standard telephone channel such signal strobing must occur with a frequency of less than 6,800 Hz (throughout the world the selected frequency for strobing of a microphone signal is 8,000 Hz), since the upper frequency component of a telephonic signal is limited by the upper frequency limit of a standard telephone channel, which is 3,400 Hz (Fig. 7).

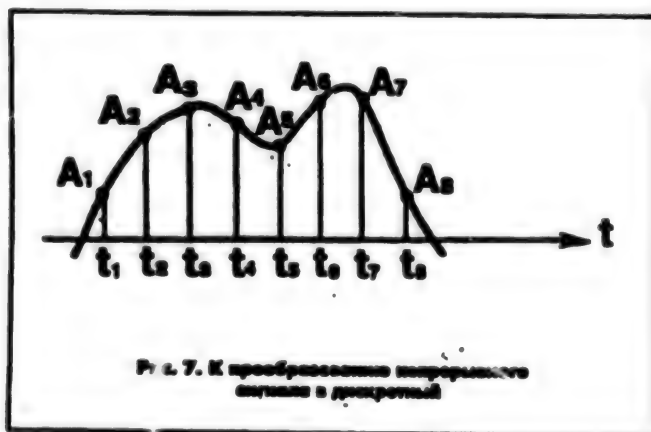


Fig. 7. Diagram explaining conversion of a continuous signal into a quantized signal.

The maximum distance between points $t_1, t_2, t_3...$ on the time axis must not exceed $T = 1/2 F$, where F is the maximum frequency component of the continuous signal. In this case the continuous curve is fully described by a series of values $[A_i]$ and the time interval Δt . If these values are represented as a set of numbers, they can be encoded by the already known method of addition with a digital number in conformity to a definite rule. By such a universal method it is possible to encode all kinds of transmitted information — from letter-digit to images. Any information is first converted into a digital form and is fed into a channel in the form of a set

of discrete digits (usually 0s and 1s). But under two conditions.

First: rapid formation of an enormous number of numerical digits for maintaining a high signal quality. In actuality, if we have 8,000 instantaneous values of a signal per second and the dynamic range of the signal is equal, for example, to 20 dB (this means that the maximum amplitude of the signal is 10 times greater than its minimum value), in one second we must have not less than $8,000 \times 4 = 32,000$ numerical binary digits (four binary digits are required for the rendering of 10 in a binary reckoning system), that is, the rate of output of

the digit and transmission into the line in this case must be not less than 32 kbit/s. Meanwhile, with the most efficient modulation methods and modems when using a standard telephone channel it is possible to achieve a rate of transmission of binary information not greater than 4.8 kbit/s.

The second condition, following from the first, is: a band for transmitting an encoded binary digit series which is far broader than for a standard telephone channel. There are, to be sure, different technical and mathematical methods making possible a sharp narrowing of the required band and transmission of the digitally encoded vocal signal through a standard telephone channel, but although speech retains an acceptable comprehensibility, the recognition of the other party from the timbre of his voice in many cases is difficult because it is synthesized by a vocal synthesizer and has a "metallic" shading. However, if a channel with a broad band is used for a signal encoded by the digital method, the quality of the vocal signal will be extremely high.

The input of keys and digital synchronization are quite complex in digital encoding of the vocal signal (as a result of high speeds of information transmission): the encoders at the receiving and transmitting ends of the communication line must begin to operate rigorously simultaneously and not diverge by one beat during the time of the entire transmission. It is necessary to retain such advantages of telephonic communication as

convenience and speed of entry into communication, which is possible only when using complex equipment, in many cases with use of devices of the computer type.

When conducting a conversation the operation of a generator of a pseudorandom series occurs in conformity to a specific algorithm and the initial setting for each new conversation is formed in the encoder again and so rapidly that the conversing parties simply do not notice this. There are telephone encoders which can operate for different communication lines, in which case the stability of protection remains identically high, but the quality of speech is the higher the broader the channel passband. Such a universality is attained by means of modems and additional communication devices (Fig. 8).

Thus, the digital encoding of information is rather complex and expensive and therefore is finding use only for the protection of information which must remain secret over a long period of time (several months), whereas for the protection of commercial, as well as personal information, the most acceptable choice is cheaper methods intended for ordinary telephone channels.

Another shortcoming of digital encoding is the possibility of keyless interpretation of some relatively simple variants of this method, although this process is so labor-intensive and prolonged that by the time it ends the information may be hopelessly outdated.

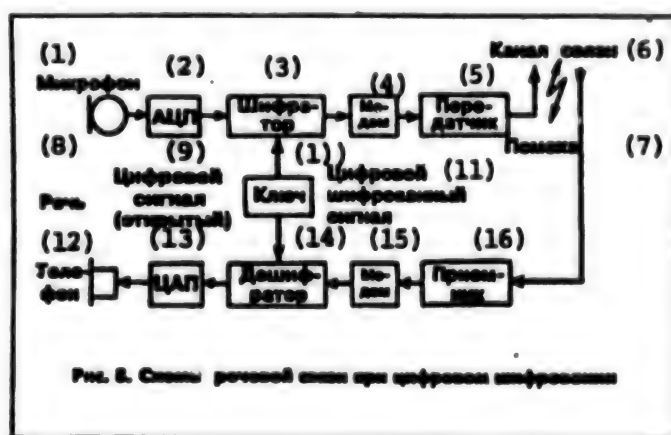


Diagram of vocal communication with digital encoding.

Key: 1. Microphone 2. Analog-to-digital computer 3. Encoder 4. Modem 5. Transmitter 6. Communication channel 7. Noise 8. Speech 9. Digital signal (open) 10. Key 11. Digital encoded signal 12. Telephone 13. Digital-to-analog computer 14. Decoder 15. Modem 16. Receiver

Choice of Encoders

Personal computers (PC), which are capable of encoding information parallel with the tasks customary for them, can be considered the most recent generation of encoders. Due to a large memory a PC ensures:

- programmed organization of several encoding algorithms, which can be made to work by pressing a key;
- programmed blocking of unauthorized access to the personal computer or to the encoding program;
- pseudorandom choice of keys providing a guarantee against repeated encoding with an already used one-time use key;
- rapid inspection of the resulting text on a display, its rapid printout or transfer to a diskette;
- connection of the personal computer via a modem to the communication channel for transmission of communications to a correspondent;
- rapid input of information from a machine-readable medium;
- concealment of the very fact of performance of digital transcription because the personal computer is a device now in common use;
- in the event of use of ultralarge permanent memory devices (streamer, laser disk CD-WORM, etc.) with a prerecorded absolute random digit
- absolutely stable encoding over an extremely long period of time, even with intensive transcription;
- possibility of development and use of one's own (unique) concealment systems, etc.

When selecting the encoding system (digital computer) it is first of all necessary to be guided by the conditions for its future operation. If it is necessary to work under specific (field) conditions, such as in a warfare situation, it must be physically strong, operate in a wide range of working temperatures and humidities, despite increased vibrations, after exposure to considerable radiation doses, etc.

The other parameters of digital systems also must include:

- configuration, size, weight;
- power supply method;
- possibility of direct operation in a communication line;
- principle for input of information data into computer;
- expanded keyboard, keyboard of 26 letters, puncher, teletype, other devices (floppy disk, magnetic tape, etc.);

— data output method: printout on narrow tape, page printing, output to punch tape, coupled teletype, monitors of different types, other media (floppy disk, magnetic tape, etc.);

— method for input of keys: from keyboard, punch cards or punch tapes, from switches, from mechanical devices, from memory (to which they must first be transferred), from a magnetic tape or other machine-readable media.

It is possible to use the following relatively simple methods for rapid evaluation of the quality of encoding by one information device or another.

1. Encode a long arbitrary text using a definite initial setting and obtain a corresponding digital text. Thereafter replace one letter in a single-use key and again encode the same text. Compare the two digital texts, especially their beginning. If they differ greatly the encoder has passed this test successfully.
2. Encode two different texts with a single key and compare the digital texts. They must be completely different.
3. Encode a long series of identical letters (for example, EEEEE...) and analyze the corresponding digital text for its "randomness": the distribution of all letters of the alphabet in the text must be identical for all letters of the digital alphabet; the distribution of bigraphs and trigraphs also must be uniform.
4. Encode different series of letters of the type E, AA, BBB, CCCC, DDDDD,... in order to see how the periodicity of segments in the open text exerts an influence on the structure of the digital text. There must be no such influence. All these types of tests must be carried out on a computer. If they have been passed successfully, the digital device is considered acceptable.

Russian Devices for Protecting Information

Maskers of telephone conversations protect them from intentional eavesdropping or interception by means of cryptographic conversion on the basis of a personal key-password of the subscriber.

The masker is a small attachment to any type of foreign or Russian telephone, which ensures, without installation of any special devices at telephone offices, the conducting of secret local and intercity conversations. The switching from an open operating mode to a secret mode and back is accomplished by pressing a button on the masker.

The user can independently set a code combination in the telephone masker and during the course of the conversation increase the degree of protection directly

from the telephone by introducing an additional code with a set of two or three digits. It is possible to use a total of more than 1 million possible digital codes. The masker supports a high quality of speech, which enables the subscribers to recognize one another by voice.

For example, the "Tuman" masker of telephone conversations (NPO Signal, St. Petersburg) is well known; it is designed in the form of an attachment situated beneath the telephone and introduced between it and the microtelephone receiver. The principle of its operation is based on the analog conversion of the vocal signal. It is impossible for an outsider to eavesdrop on a conversation over a telephone not supplied with an analog converter.

Principal technical specifications of "Tuman" masker

Operating mode — open, protected Range of working frequencies — 0.3-3.4 kHz Nonuniformity of amplitude-frequency characteristic of through channel in range of working frequencies — 12 dB Coefficient of nonlinear signal distortions — 10% Current required from power source — 20 mA Power for conversion from built-in 7D-0.115 storage battery ("Krona" battery) or from an alternating current network with a voltage 220 V (50 Hz) Duration of masked telephonic conversations with power supply from BPS- 9/0.3, incorporated in masker outfit — unlimited Dimensions — 200 x 250 mm Weight, kg: masker — 0.7 BPS-9/0.3 — 0.3

Other characteristics of the masker may be the number of codes (up to a million), method for key input (switches, dial), encoding method, correspondence of signal parameters in communication channel to state standard GOST 7135-85, comprehensibility of retrieved vocal signal, time of instrument lag of vocal signal in transmission-reception channel.

Masks also are known in such makes as "Selena" (Tekhnopros Science-Technology Center, Moscow), "Bazalt" (Progress Joint-Stock Company, Ufa); "Issa" and "Uza" (Electronic Equipment Items Scientific Research Institute, Penza).

The "Issa" subscriber terminal masker (Fig. 9) makes it possible to transmit confidential information and data through telephone channels of the general-use network and also through a decimeter radio station, protecting it from deliberate and accidental distortions of digits and imposition of spurious communications. It ensures:

- initial connection among subscribers using telephone equipment (for portable variant
- including dial telephone) or microtelephone fittings of radio station;

— possibility for connection directly to telephone line or radio station;

— half-duplex operating mode in communication channel with speeds 1,200/600 bit/s;

— transmission of communication of a letter-digit text with a volume up to 2,560 digits (1 sheet of format A4) during a session;

— average time for delivery of communication — 1.2 min;

— input, output and editing of text;

— storage of assembled information (when there is a charged battery in the terminal — not less than 72 hours;

— setting of key from built-in keyboard.

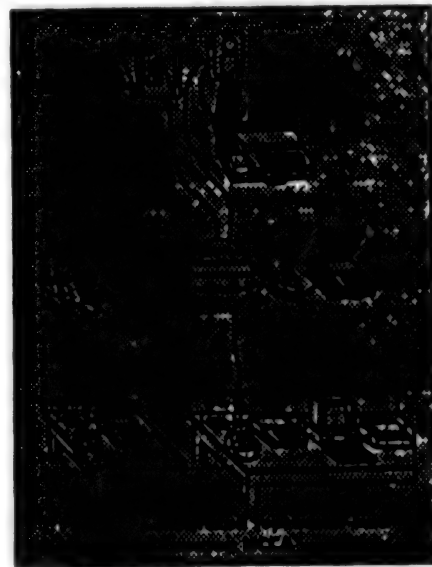


Fig. 9. Subscriber's terminal — Issa masker.

Local systems for on-line confidential communication can be constructed on the basis of the "Uza" masker.

Devices for transmission of confidential information are intended for ensuring secrecy and transmission through the general-use telephone channel of confidential communications constituting a commercial secret. The makeup of such an item, such as the so-called Vual, includes a small keyboard of the calculator type, a device for the input and output of communications and a power unit. In addition, it can be supplemented by a device for the documenting of communications.

The principal specifications of the Vual are:

Volume of text buffer, digits:

received from communication channel — 512

introduced from the keyboard — 750

storable with cutting-in of power supply — 256

Alphabet of open text — Russian and Latin letters, digits, symbols

Rate of transmission in general-use telephone network channel — 25 digits/s

Display of processed information — with liquid-crystal indicator in 16-digit form in moving line or line-by-line mode Length of key — 16 or 32 digits

Simultaneous storage in device memory — up to 5 keys

Warranted time of use of key without decrease in reliability of secrecy of information with length of key 16 digits — 1 year

Length of password — 1-8 digits

Time of storage of keys without replacement of elements — 6 months

Powering for key memory device — from RTs-53 U elements

Powering of device from built-in A332 elements or from alternating current network with voltage — 220 V (50 Hz)

Time of continuous operation in autonomous mode — 6 hours Weight — 1.5 kg

The device provides for the possibilities of:

— connection of a specialized printer and editing of information in the course of its input from the keyboard;

— organization of circular and selective communication;

— protection against unauthorized access to key stored in memory device by means of a password;

— forming of keys with direct use of device.

The merits of the Vual include the presence of a key-forming mode, the possibility of a change in its length, convenience in communication with operator, possibility of organizing a network and individual communications.

Cryptocards are intended for encoding information stored in the internal and peripheral memories of a personal computer.

The high-speed cryptocard with Mega software makes it possible to process information at a rate 0.8 Mbyte/s with allowance for a computer interface operating at an audio frequency 12 MHz. It is built into a personal computer of the IBM PC/AT type and has an original algorithm. The number of protected files is unlimited.

The software ensures:

— formation of a multikey system (length of initial key — 2,048 bytes);

— linking with a package of communication programs for modem operation;

— authentication mode;

— support of cryptocard interface.

Memory volume 300 Kbyte. The service package provides a user's menu and assistance to the user in software orientation. The supplied package includes a card and diskette.

Scramblers are intended for the protection of telephone conversations against unauthorized eavesdropping on the line.

For example, the CTA-1000 analog-to-digital scrambler is designed in the form of a small attachment to a desk telephone of any Russian or imported make, is connected to the general-use telephone network and operates in a duplex mode.

The principal technical specifications of scramblers are given in Table 3.

Equipment for encoding speech and digital information is intended for duplex, half-duplex (E-24D) and simplex (E-24D and E-24) radio channels operating in the meter and decimeter ranges, having an input-output in accordance with the international standard S1-I. It also ensures the encoding of speech when there is a high noise level (in tanks, armored personnel carriers, helicopters) and digital information arriving from a source with a speed 1,200 bit/s, transmitted via decimeter radio or wire communication lines.

Speech is subjected to quantization by delta modulation methods at a rate 16 or 32 kbit/s with subsequent digital encoding. The encoding of information in digital form makes the equipment suitable for operation in telephone networks. The input of a key is possible using an external input device.

Table 3

| Technical specification | Make of scrambler | | |
|--------------------------|-------------------|------------------------|----------------------------|
| | CTA-1000 | G 135/P | SCR-M 1.2 |
| No. of code combinations | | 10 ⁶ | 10 ⁷ |
| Key length | up to 16 digits | - | - |
| Consumed power, W | 6 | 1.5 | 10 |
| Dimensions, mm | 330x260x65 | 285x215x35 | 250x275x65 |
| Weight, kg | 3 | 1.5 | 3 |
| Manufacturer-supplier | TOO Geros, Moscow | Grotek Company, Moscow | Mascom Association, Moscow |

In a simplex mode the E-24D operates together with the E-24 portable variant, ensuring a high quality of the interpreted speech and the possibility of further transmission through vocoder systems (for example, through the Ye9 encoding system produced in Russia).

The equipment is adapted for placement in supports of both stationary and mobile systems, as well as in moving vehicles, on naval ships and in a portable variant, for which there are 11 delivery variants.

Principal technical specifications

Length of key ... 128 bit Number of key combinations ... 1×10^8 Number of key settings stored in memory ... 2 Time for key input ... 1.5 min Acoustic noise level ... 100 dB Key input device ... VYe-24 Synchronization device ... 1.5 s

Telephones with encoded vocal information ensure confidentiality of telephone conversations. They are ordinary telephones with a built-in device for the protection of vocal information. For example, such a telephone is the G 136/P, fabricated on the basis of the standard telephone VEF TA-12 with retention of all its functions and without a change in external appearance (a design in the form of the G 137/P handset); it prevents eavesdropping on telephone conversations on an extension phone both in a protection of conversations mode and in an ordinary mode.

The activation and deactivation of an information protection mode is possible in any stage of the telephone conversation by pressing a button present on the front panel of the telephone. In the information protection mode there is a guarantee not only of the encoding of conversations, but it also is impossible for an outsider to identify subscribers from the timbre of the voice, accent, manner of conducting the conversation and other indirect criteria. A conversation in an information protection mode is possible only with subscribers having telephones of the same series.

The equipment does not require the installation of special devices at telephone offices and makes it possible to conduct secret local and intercity telephone conversations.

Equipment for the protection of conversations against eavesdropping and recording guarantees confidentiality when they are conducted in any room (apartment, office, hospital ward, etc.), does not require special training of users and is an alternative for costly search instruments (measures). For example, by using the G108/P mobile outfit for protection against eavesdropping local masking noise is generated and there is special electronic processing of vocal signals; with the participation of up to four persons in a conversation there is a possibility for individual regulation of loudness and a level of acoustic masking noise not less than 94 dB. (Consumed power less than 5 W, dimensions 300 x 20 x 50 mm, weight 6 kg, time required for preparing the equipment for operation not more than 3 minutes).

Network filters are intended for the protection of feeder lines in buildings, computer centers, computers, etc. against power network noise, for counteracting the leakage of commercial information through power circuits and unauthorized access to the processed information through power circuits.

For example, the SFP-60-4 superfilter is a combined noise-suppressing device combining the functions of a radio noise filter, device for protection against brief pulsed noise (the parameters of the introduced pulsed noise are defined by the IEC 1000-4-01 international standard or the corresponding state standard GOST 29280-92) and a filter for protection of the network against leakage by conduction (through wires) of signals generated in the power circuits by information processing devices.

The superfilter is installed between the circuit breaker box of the building (or floor) and the system for conveying electric power through the building (floor).

Table 4

| Parameter | SmartAccess | Krypton | Kryptolet |
|--------------------|---------------|---------------|--------------|
| Secrecy stamp | Any | Any | Confidential |
| Encoding algorithm | GOST 28147-89 | GOST 28147-89 | Special |
| Encoding rate | 200 Kbyte/s | 200 Kbyte/s | 2 Mbyte/s |
| Length of key | 256 bit | 256 bit | 32 bit |
| Key | Smart card | Diakette | Diskette |
| Memory size | 15-40 Kbyte | 15-40 Kbyte | 6 Kbyte |
| Equipment used | Krypton-IR | Krypton-3 | Special card |

Computer security systems. The encoding methods and equipment presently used in the field of protection of information transmitted through communication lines have attained a high degree of complexity and diversity, high stability and reliability of the generated digits. The appearance of personal computers has opened a new era in the protection of commercial and private communication. There is a possibility for a broad choice of encoding methods and algorithms, including the above-mentioned DES algorithm, ensuring high security during the storage and transmission of computer information. Russian-produced programs and programming equipment have been developed and are being sold in our country for affording protection of computer and telephonic information. For example, the computer security systems SmartAccess, Krypton and Kryptolet are programming complexes ensuring protection of information stored in a computer and restriction of access to it by users. The systems are intended for operation with an IBM-compatible personal computer of the XT or AT type. The principal parameters of the systems are given in Table 4.

The structuring concept for these systems provides for:

- entry into the system only after entering the password and key;
- restriction of access of users to the logic disk;
- encoding of information on the winchester and diskettes;
- protection against entry into the system from a diskette;
- special repeaters for system administrators;
- allowance for all modern requirements on the protection of information;
- automation of all processes.

If for one reason or another one does not trust or does not desire to use the passwords or algorithms provided by others it is possible to formulate one's own. It is true that it must be noted that an incompetently developed algorithm may result in extremely unstable encoding and therefore it is necessary to be confident of the stability of the developed system.

With respect to methods for unauthorized decoding of information, the absolute expenditures of time, energy and money on them are so great that the process becomes considerably more costly than the value of that information which one intends to obtain. Moreover, even a relatively simple algorithm is quite difficult to interpret if the potential opponent does not know the encoding system used, the volume of the communication is short, the keys are changed quite frequently and the encoding is performed without errors.

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Effect of Ion Bombardment on Alloys of the System Titanium-Aluminum

957A0919A Yekaterinburg FIZIKA METALLOV I METALLOVEDENIYE in Russian Mar 95 No 3, pp 101-103

[Article by V.P. Kiryushin, V.D. Melikhov, and T.V. Volkova, Physicotechnical Institute, Republic of Kazakhstan Academy of Sciences; manuscript received 13 Jul 94; UDC 669.71'295:539.12.04]

[FBIS Abstract] A study examined the effects of ion bombardment (Ti^+ , 60 keV) on the structure of two two-phase titanium-aluminum alloys. The first alloy contained aluminum in the amount of 40 atomic percent and the second alloy contained aluminum in the amount of 48 atomic percent. Each of the two alloys contained two phases, i.e., Ti_3Al (α -phase) and $TiAl$ (γ -phase). Metallographic analysis of samples of the two alloys indicated that the alloy containing aluminum in the amount of 40 atomic percent consisted of grains measuring 2.2-2.5 mm in diameter and had quite distinct bleeding along the grain boundaries. Microhardness measurements established that the region of bleeding along the grain boundaries corresponded to segregations of α -phase ($H_v^{80} = 630$ units) while the grain bodies consisted primarily of γ -phase ($H_v^{80} = 500$ -550 units). In the alloy containing aluminum in the amount of 48 atomic percent the grains ranged from 2.8 to 3 mm in diameter, and the areas near the grain boundaries were virtually free of segregations. Little variance was found in the said alloy's microhardness ($H_v^{80} = 420$ units), which is to say that it contained a very small amount of α -phase (Ti_3Al). A Diana ion accelerator (Physicotechnical Institute, Republic of Kazakhstan Academy of Sciences) was used to bombard the two alloys with Ti^+ ions with an energy of 60 keV. During the ion bombardment, the alloys' temperature never exceeded 180°C. In the case of the alloy containing aluminum in the amount of 40 atomic percent, ion bombardment resulted in a decrease in internal intensity of the lines of the α -phase and a simultaneous increase in the intensity of the structural reflections of the γ -phase and a decrease in the intensity of the ultrastructural reflections of the γ -phase. Ion bombardment changed the percent concentration of phases in both two-phase alloys studied and also altered the lattice parameters and degree of long-range order in the location of the atoms in the lattice of the compound $TiAl$. Specifically, the level of Ti_3Al in the alloy containing aluminum in the amount of 40 atomic percent decreased from 13 percent (by volume) before ion bombardment to 4 percent (by volume) after ion bombardment. In the alloy containing aluminum in the amount of 48 atomic percent, the α -phase dissolved after bombardment with a fluence of 1.4×10^{16} ions/cm² (it was

present in the nonirradiated alloy at a level of 7 percent). Studies of the microstructure of the bombarded alloys established that their grain sizes remained virtually unchanged. In the alloy containing aluminum in the amount of 40 atomic percent, however, there was a significant narrowing of the near-grain boundary regions and a clear decrease in microhardness (by 15 percent) that was concluded to possibly be linked to dissolution of the α -phase. In the alloy containing aluminum in the amount of 48 atomic percent, the change in nature of the grain boundaries was less visible; however, its microhardness also decreased (by 10 percent). It was suggested that the fact that the effects of ion bombardment were less apparent in the alloy containing aluminum in the amount of 48 atomic percent may be linked to the lower concentration of α -phase in the starting alloy compared to that in the starting alloy containing aluminum in the amount of 40 atomic percent. In the alloy containing aluminum in the amount of 40 atomic percent, ion bombardment destroyed the structure in the near-surface layer to a depth of 30 nm (0.03 μ m). On the basis of a comparison of the two parameters depth of penetration of the bombarding ions and size of the layer in which phase restructuring occurred (0.03 and 8 μ m, respectively), it was hypothesized that the ion bombardment-initiated phase transitions and restructuring of heterogeneous titanium-aluminum mixtures are not limited to the implanted layer but are instead propagated to a depth exceeding the implanted layer by two orders of magnitude. Figure 1, table 1; references 5: 4 Russian, 1 Western.

Epitaxial Growth of TiN Layer With Implantation of Ti^+ Ions Into Mo in a Nitrogen Atmosphere and the Effect of Radiation and Heat Treatment on the Structure of the Coating-Substrate Transition Layer

957A0919B Yekaterinburg FIZIKA METALLOV I METALLOVEDENIYE in Russian Mar 95 No 3, pp 112-120

[Article by I.V. Lyasotskiy, D.V. Shtanskiy, N.B. Dyakonova, and N.T. Travina, Physicotechnological Center, All-Russian Scientific Research Institute of Ferrous Metallurgy; manuscript received 9 Mar 94; after revision 20 Oct 94; UDC 669.28:539.12.04:620.186.1.548.4]

[FBIS Abstract] A study examined the coating-substrate transition layer formed when Ti^+ ions are implanted into a molybdenum substrate in a nitrogen atmosphere and the subsequent structural changes that occur when the resultant layers are subjected to radiation-heat treatment. A Diana-2 ion accelerator was used to implant the Ti^+ ions into a substrate cut from a strip of rolled molybdenum strip. The process was conducted in a nitrogen

atmosphere with a nitrogen pressure of 0.13 Pa. The conditions of the ion implantation process were as follows: accelerating voltage, 60 kV; pulse duration, 300 μ s; pulse following frequency, 2.5-5 Hz; current density in the pulse, approximately 2 mA/cm²; and irradiation dose, 10¹⁷ ions/cm². An Elektronika U-003 accelerator was then used for radiation-heat treatment of the samples under the following conditions: electron energy, 4 MeV; current in the beam, 700 mA; beam diameter at the outlet, 5-10 mm; and irradiation time, 120 minutes. The substrate temperature did not exceed 150°C. Auger electron spectroscopy with a JAMP-10 unit was used to plot the curves of the concentration distribution of Ti, N, and C after implantation. A Geigerflex diffractometer was used to record the alloys' x-ray spectra, and a JEOL 200CX electron microscope was used to examine their structures. X-ray analysis confirmed that the main result of the ion implantation process implemented was the formation of thin (approximately 200 nm thick) layers of TiN with a face-centered lattice on the modified surface. The implanted Ti⁺ and N⁺ region was 600 nm thick, with the two elements being virtually completely distributed in an even narrower zone (not exceeding 400 nm wide) so that the width of the area in which the two elements did not mix with the substrate was only 200 nm wide. The maximum concentration of titanium achieved was 41 atomic percent. A transition layer formed at the coating-substrate boundary in which the concentration of titanium was comparatively low (25-30 atomic percent) and the concentration of molybdenum was rather high (approximately 30-50 atomic percent). Electron microscopy analysis of a section of the coating-substrate interface after it had been subjected to electrolytic etching on one side revealed a four layer structure (total thickness, 100 nm) consisting of the following layers from the outer surface inward: TiN (fine-grained with no texture), TiN (coarse-grained and textured), a metastable GPU [not further identified] phase linking the lattices of the matrix and coating, and molybdenum. Radiation-heat treatment resulted in recrystallization of the structure at the coating-substrate interface, which in turn resulted primarily in restructuring of the textureless TiN grains and disappearance of the GPU phase in the transition layer. Figures 5; references 6: 4 Russian, 2 Western.

Mechanical Properties and Recrystallization of Alumina Ceramic Reinforced With SiC Whiskers

957A0958A Moscow OGNEUPORY in Russian
May 95 No 5, pp 8-12

[Article by G.Ye. Valyano, candidate of technical sciences, Special Institute of High Temperatures, D.A. Ivanov, A.V. Krylov, and N.A. Mindlina, Interdepartmental Scientific Research Center for Engineer-

ing Ceramics, Russian Academy of Sciences; UDC 666.762.1.017:539.4.015]

[FBIS Abstract] Hot pressed alumina ceramic reinforced with SiC whiskers features a high strength and a high erosion resistance at temperatures up to 1200°C. In air, however, its useful life is shortened by oxidation of the SiC whiskers, especially fast at temperatures above 800°C, so that a protective coating is needed for retardation of this process. An experimental study of such a ceramic was made concerning the dependence of its mechanical properties and of the degree of alumina recrystallization on the processing conditions. Two grades of GLMK Al₂O₃ + 0.5% MgO powder were used: one of the 1-2 μ m grain size fraction produced under laboratory conditions and one of the 0.3-0.5 μ m grain size fraction with not less than 95% γ -Al₂O₃ produced by the sol-gel method. The β -SiC whiskers were 0.3-1.5 μ m in diameter and 12-200 μ m long. Their content was varied from 0 (pure powder) to 50 vol.%. Specimens of composite ceramic were formed in graphite molds by hot pressing under a pressure of 30 MPa at temperatures covering the 1600-1900°C range, either in air or in an argon atmosphere. Decrease of strength due to formation of porous inclusions was prevented by thorough mixing of the ingredients so as to avoid agglomeration of SiC whiskers. The specimens were tested for flexural strength at temperatures ranging from 20°C to 1400°C after hot pressing at temperatures 1600°C to 1900°C and subsequent 15-45 min long isothermal soaking in air, also after quench cycles from 1000°C to 15°C in water. They were tested for oxidation in air at 1000°C over an at least 100 h long period. For comparison were also tested specimens without whiskers and specimens of the 3Al₂O₃ + 2SiO₂ material. The recrystallization of alumina was evaluated by interpretation of microstructure data on the basis of two theoretical relations: $D = k\tau^{1/2}$ relation describing the grain growth kinetics) and $v = \gamma(4\delta/D - P) = dD/dt$ describing the slowdown of grain boundaries migration (D -largest grain dimension; τ - length of isothermal soaking time; k - proportionality factor; γ - coefficient dependent on the temperature and the phase composition of grains; δ - specific surface energy of grain boundary, equivalent to surface tension; P - retarding force developed by grain boundary, per unit surface area, t - time. Whiskers are assumed to be cylindrical inclusions with a large length-to-diameter. Interaction between grain boundaries and cylinder bases is assumed to have negligible consequences and no penetration of grains by whiskers is assumed to take place. The results of this study indicate that alumina powder produced by the sol-gel method with 20 vol.% SiC whiskers makes the best material, the optimum range of whisker length being 1-5 μ m for hot pressing at any temperature within the 1600-1900°C range. This mate-

rial is suitable for cutting tools which must withstand thermomechanical stresses and abrasive wear. Figures 6; tables 1; references 13.

Phase Equilibria and Formation of Eutectic Structure in Alloys of Chromium With Titanium Nitride

957A1013A Kiev METALLOFIZIKA I NOVEYSHIYE TEKHNologii in Russian Jun 95 No 6, (manuscript received 13 Mar 95) pp 35-39

[Article by V. G. Ivanchenko, T. V. Melnichenko and L. M. Vasilyeva, Institute of Metal Physics, Ukrainian National Academy of Sciences; UDC 669.26:669.017]

[FBIS Abstract] The authors study specimens of alloys in the ternary system Cr-Ti-N with different ratios of N/Ti in region ($\alpha + \delta$), where α is a solid solution of titanium and nitrogen in chromium, and δ is a solid solution based on $TiN_{0.96}$. Metallographic and phase x-ray analysis confirmed the existence of a quasibinary section of eutectic type between the chromium-based solid solution and titanium nitride. The section was identified as $Cr_{0.991}Ti_{0.009}-TiN_{0.96}$, crystallizing at a constant temperature of 1826°C. The Cr-Ti-N eutectic is of polyhedron-dendritic type in which titanium nitride is responsible for nucleation and eutectic crystallization. The anomalous and irregular structure of the eutectic can be attributed to the low volumetric content and high melting point of titanium nitride. Figures 3, references 5.

Effect of the Structure of Boron-Containing Iron Matrix Composites on Wear Processes

957A1024A Kiev AVTOMATICHESKAYA SVARKA in Russian Jul 95 No 7, (manuscript received 5 Sep 94) pp 25-27

[Article by I. M. Spiridonova, Ye. V. Sukhovaya, K.A. Yushchenko, Dnepropetrov State University, Ye. O. Paton Institute of Arc Welding, National Academy of Sciences of Ukraine; UDC 621.793:669.15'781.018.95:620.18:620.178.1]

[FBIS Abstract] This paper studies the structure and properties of composite materials with an iron-boron-carbon matrix of eutectic composition with a tungsten carbide filler. The effect of composite structure on wear resistance is demonstrated in gas abrasive wear. Optimal temperature-time modes to obtain composites with heightened wear resistance are established. These

composites have a matrix that has a structure that provides an optimal combination of durability and viscosity and equal probability of brittle or viscous destruction. The maximum wear resistance is found in alloys obtained in the following optimal mode: T - 1150-1170°C, t = 40-60 minutes. Figures 3; references 1 (Russian).

Effect of Plasma Application Conditions on the Structure of Fe-Mo-Cr-Ni-B Alloy Coatings

957A1024B Kiev AVTOMATICHESKAYA SVARKA in Russian Jul 95 No 7, (manuscript received 8 Dec 94) pp 28-34

[Article by A. L. Borisova, V. G. Bobrik, Yu. S. Borisov, V. N. Korzhik, G. N. Gordan, V. V. Borisov, S. V. Petrov; Ye. O. Paton Institute of Arc Welding, Institute of Gas, National Academy of Sciences of Ukraine UDC 621.193.72:533.9:[669.15'28'26'24'781:620.18]]

[FBIS Abstract] An amorphous-crystalline structure is formed in plasma application of an Fe-Mo-Cr-Ni-B alloy. The structure includes a matrix with an amorphous structure, crystalline inclusions of complex boride $Mo_2(Fe, Cr)B_2$, and eutectics consisting of a solid solution based on α -iron or γ -iron and boride $(Fe, Cr, Ni)_2B$. Supersonic plasma application increases particle speed by a factor of 4-5 (up to 500 m/s) which increases the kinetic energy of the applied particles and the degree of their deformation. The average thickness of disks of hardened particles decreases from 15 to 5 μm . This is the main reason for an increase of up to 90 percent in the degree of amorphization of the applied material in supersonic air-gas plasma application, compared with 65 percent in subsonic application. The increase in the intensity of cooling of the base when immersed in water increases the speed of hardening of the particles and reduces the degree of deformation, which in turn decreases (up to 75 percent) the degree of amorphousness of the coatings. The amorphization of the coating depends on the thickness and initial temperature of the hardening deformed particle, its gas saturation and oxidation, the temperature and composition of the underlying material, and the thickness of the applied coating. The coatings obtained here are shown to be highly durable and corrosion- and wear-resistant. Figures 8; tables 3; references 14: 5 Russian, 9 Western.

Aluminum-Lithium Alloys for Welded Aerospace Equipment (Overview)

957A1024C Kiev AVTOMATICHESKAYA SVARKA in Russian Jul 95 No 7, (manuscript received 23 Feb 95; after revision 18 Apr 95) pp 41-44

[Article by A. Ya. Ishchenko, T. M. Labur, A. V. Lozovskaya; Ye. O. Paton Institute of Arc Welding, National Academy of Sciences of Ukraine; UDC 621.791.669.715'884:629.7(047)]

[FBIS Abstract] This paper examines basic solutions to the problems of welding aluminum-lithium alloys with various alloy systems (Al-Mg-Li, Al-Cu-Li, Al-Cu-Mg-Li). Lithium alloy welded joints tend to form pores and hot cracks. This is due to the high content of gas-forming compounds in surface layers. Recommendations are made to prevent the formation of pores and hot cracks. These defects can be partially eliminated with pulsed arc welding with a nonconsumable electrode. Porosity can be almost completely eliminated by machining the surface and degassing the welding pool. Techniques to reduce or eliminate hot cracks are discussed. Approaches to the welding of lithium alloys are presented which increase the durability and viscosity of destruction of welded joints, and decrease their sensitivity to stress concentrators and embrittlement at low temperatures. Service properties of lithium alloy welded joints are presented. Figures 2; tables 3; references 19 (Russian).

Features of Surface Cleaning of Oxides From Titanium Parts in Arc Soldering in Vacuum

957A1024D Kiev AVTOMATICHESKAYA SVARKA in Russian Jul 95 No 7, (manuscript received 31 Jan 95) pp 60-62

[Article by V. M. Nerovnyy, V. V. Peremitko; N. E. Bauman, Moscow State Technical University, Dneprodzerzhin State Technical University; UDC 621.791.3-2:[669.295:621.7.02.002]

[FBIS Abstract] The kinetics of cleaning oxides from the surface of titanium parts is studied. The parts are treated with a stream of arc discharge plasma with a hollow cathode in vacuum. The plasma stream is a more effective protective medium than the residual atmosphere because the partial pressure of oxygen is a factor of 5-10 lower. According to calculations, in the case of preliminary processing and degreasing of the surface of a titanium part, the process of cleaning oxide film from the part occurs during the stage of heating by the plasma stream and occurs in 1×10^{-5} seconds. This makes it possible to combine the operations of surface activation and application of a coating in soldering mode. When a coating is applied to titanium alloys using arc soldering in vacuum with delivery of powdered composite solders, an increase in the concentration of oxygen in the surface layer of the base metal is not observed. This indicates that embrittlement of the surface layer due to oxygen saturation does not occur in arc brazing in vacuum. Figure 1; references 6 (Russian).

Influence That Sensitivity Scatter and Cell Noise of a Multicell Photosensor Have on Effectiveness of Detecting Lidar Pulse Signal

957A1011A St. Petersburg OPTICHESKIY ZHURNAL in Russian Mar 95 No 3, (manuscript received 12 Jul 94) pp 37-39

[Article by V. P. Kostin, candidate of technical sciences, Kiev Military Air Force Institute; UDC 621.383.4'3]

[FBIS Abstract] In a previous paper, the author derived analytical expressions for determining the optimum structure of a multicell photoreceiver with identical cells. In this paper, these relations are extended to evaluate the effect of scatter in sensitivity and noise of cells on the probability of detection and false alarm of a pulsed lidar signal. It is shown that when signals to be detected are weak, a multicell photosensor with a spread in sensitivity of photocells is slightly more effective than a receiver with uniform sensitivity, while a sensor with sensitivity scatter is less effective in the case of stronger signals. It is recommended that uniformity of sensitivity be maximized, as the minimum probability of signal detection may fall below the required threshold when the circle of confusion falls on a cell with reduced sensitivity. Furthermore, scatter of internal and external noises may make it necessary to increase the detection threshold, as the probability of a false alarm in the presence of such scatter increases in proportion to the threshold of detection. Figures 2, references 4.

Aerosol Particle Counter Based on Heterochromatic Interference Bands

957A1011B St. Petersburg OPTICHESKIY ZHURNAL in Russian Mar 95 No 3, (manuscript received 14 Mar 94) pp 45-48

[Article by P. Yu. Ivanova, Yu. Ye. Polskiy and N. V. Filippova, Kazan State Technical University; UDC 543.275.08:621.383.001.2]

[FBIS Abstract] To reduce the influence of inhomogeneities in determination of aerosol particle size, improve accuracy and extend the particle size range, as well as to increase the range of measurable concentrations, the authors propose a new interferometric method in which color separation and converging optical systems are used to form equidistant interference bands with different periods for different wavelengths in the particle count volume. Light scattered by each particle passing through such a count volume perpendicular to the band system is routed to photocells, each sensing radiation on only one of the wavelengths. The percentage modulation of the signal at the output of each photocell depends on the ratio between particle size and the spacing of the interference pattern, eliminating the

uncertainty of counts inherent to other interferometric methods. Since the information about particle size is given by the percentage modulation of reflected light, it does not depend on the absolute value of the scattering coefficient. Also, any standard optical technique can be used to form equidistant bands with the required period. Analysis shows that the new method of determining aerosol particle size is free of diffraction limitations. Maximum measurable concentration without dilution of the sample is $5 \times 10^5 \text{ cm}^{-3}$. Relations are derived for designing a practical counter based on the proposed method. Figures 4, references 10.

Influence of Tool Trajectories on Final Sizing of Precision Flat Ceramic Parts

957A1011C St. Petersburg OPTICHESKIY ZHURNAL in Russian Mar 95 No 3, (manuscript received 17 Nov 93) pp 57-61

[Article by A. A. Orap, candidate of technical sciences, N. Ye. Stakhniv, candidate of technical sciences, S. V. Sokhan, candidate of technical sciences, and Ye. V. Senchenko, Institute of Ultrahard Materials, Ukrainian Academy of Sciences; UDC 681.7.054.3:666.3]

[FBIS Abstract] The authors attempt to analyze the influence that trajectories of diamond tools have on final polishing of flat ceramic parts with optical precision on machines with driver end effectors. Under these conditions, free rotation of the upper link (tool) on a ball-and-socket joint precludes kinematic control of the trajectories of abrasive grains. Results of model studies show that the depth of penetration of a diamond grain into the surface of the workpiece increases by a factor of 1.5-3 in the vicinity of turning loops. Recommendations are made for stabilizing relative tool velocity to reduce this effect. Figures 5, tables 2, references 6.

A Means of Eliminating the Consequences of the Accident at the Chernobyl Nuclear Power Station

957A1033A Moscow ATOMNAYA ENERGIYA in Russian Mar 95 No 3, pp 214-217

[Article by N. A. Yermolov, RF State Scientific Center, FEI (not further identified); UDC 621.039.583]

[FBIS Translated Text] The Shelter facility built at the Chernobyl Nuclear Power Station right after the accident contains radioactive materials, parts and units of the disintegrated reactor, fuel in the form of a lava-like fuel-containing mass, materials used to contain the accident and contaminated by radioactive substances, and fragments of structural members and equipment. There are openings into the roof and walls of the shelter. Their total area in 1992 was 1,000 m² [1]. Precipitation and moist air enter through them, and radioactive dust

is able to exit to the outside and contaminate the station territory. Water is accelerating all disintegration processes occurring inside the Shelter, washing out fuel and radioactive substances, dissolving them, and carrying them into the water table.

By early 1992 the condition of load-bearing structural members had not changed significantly, and the 30-year life for which the Shelter was planned seemed to be a realistic forecast [1].

Two means of decontaminating the Shelter facility are often discussed. 1. Decontamination by filling interior spaces of the reactor block with concrete to the +41.0 m mark, and to a lower height in interior spaces of the rest of the building.

In order to create this monolithic structure, we would have to prepare and pour over 300,000 m³ of concrete. Disintegration of the structure would begin right after its creation. The concrete mass would undergo continuous disintegration due to the high chemical activity of the radioactive materials and fuel, which is still releasing heat, confined within it. With time, it will become necessary to carry out a second phase: The concrete of this structure will have to be cut into chunks, and processed and removed like radioactive wastes.

2. Erection of an additional shell with a life of 100 years or more encompassing the first shell—the Shelter facility—above the ground surface, subsequent erection of an enterprise nearby to process the radioactive materials and objects, recovery of materials and objects from the Shelter facility for processing, and their removal. This means is sometimes considered to be preferable because of the notion that the additional shell could be of such high quality that it would stop entry of water into the Shelter facility and the spread of radioactive substances out of it into the environment. In reality however, this is a deceptive notion. It is impossible to seal off the shell from below. Nor will it be leak-tight above ground, because large quantities of materials and objects recovered from the Shelter facility will have to be passed through it for processing. Consequently the additional shell will not keep outside air and its moisture from entering it and the Shelter facility. The main cause of entry of water into the Shelter facility is basically condensation of moisture on interior cooled surfaces exposed to moist air. Entry of water increases with growth of the amount by which the ambient air temperature exceeds the temperature of the objects contained inside, because this increases the difference between the absolute air humidity outside and inside the facility.

In principle, condensation of moisture can be prevented only by making the Shelter facility leak-tight, which

is impossible, or by organized input of dry air, which would require construction of dryers and ventilation equipment operating year-round. A third way of solving the problem—by keeping the temperature inside the Shelter facility higher than ambient air temperature—requires installation of a constantly operating heating system. However, this cannot be done because of the great overall height of spaces contained within the Shelter facility: Hot and cold air will undergo considerable horizontal stratification.

Thus an additional shell will not stop entry of water into the Shelter facility. Disintegrating in response to radiation, the fuel-containing mass contained within it will be carried out by water into the water table, because the additional shell will not be sealed from below. There are other shortcomings with this means as well:

- before the shell is created, loose ground that will be supporting it will have to be compacted in order to reduce nonuniformity of the shell's settling [2];

- ionizing radiation is present in places where the work of creating the additional shell is to be carried out;

- the requirements on the shell's strength are high, as consequently are the technical complexity and the materials- and labor-intensiveness of construction;

- a system must be created to monitor the condition of the shell and radioactive substances confined within the Shelter facility, and operating and repair personnel must be trained to service these systems and shells;

- dismantling of the damaged block can be started only after the less-radioactive materials and objects located externally and serving as shielding against ionizing radiation from the fuel-containing mass contained within are removed. As the distance from it gradually decreases, the exposure dose within the entire space encompassed by the shell will continually increase;

- we can anticipate that because of the listed shortcomings of this method, its implementation will mean a high cumulative dose;

- after all radioactive substances, objects and materials are recovered from the Shelter facility, the question as to the further use of the additional shell will arise.

Proposed Method for Doing Away With the Shelter Facility

The method proposed here essentially involves first recovering fuel and fuel-containing mass from the Shelter facility for processing, followed by recovery of the rest of the radioactive materials and objects and their processing, dismantling the Shelter facility and processing of its radioactive fragments, and placing the

processed radioactive substances, materials and objects in radioactive waste storage facilities.

The method requires:

- building a room beneath the damaged power block in which to receive substances, materials and objects from the Shelter, which could then be sorted in the room into solids and liquids and in relation to radioactivity, stowed in transport containers, and delivered for processing. The receiving room would communicate with the ground surface by tunnels, and it would be outfitted with repairable equipment controlled remotely and (or) from shielded cabins. Locating the receiving room in this way would make it possible to come near the fuel and the fuel-containing mass, prepare for their removal from the Shelter, and remove them on priority without exposing builders and personnel. Materials and objects in the receiving room could be delivered through vertical and (or) sloping passageways between them. After the bulk of the fuel and fuel-containing mass in spaces beneath the reactor is removed, removal of the rest of the materials and objects would become much simpler. Personnel working in the receiving room would be in shielded boxes. Because the receiving room is located in this way and the builders and personnel are shielded, the overall dose received during the work of recovering the radioactive substances, materials and objects from the Shelter facility and their transportation for processing would be minimal;

- building a radioactive waste storage facility and an enterprise to process the radioactive substances, materials and objects in places suitable for their storage, and supplying the storage facility and the enterprise with repairable equipment controlled remotely and (or) from shielded cabins. At the enterprise, the fuel will be isolated, and radioactive materials and objects removed from the fuel will be mixed with concrete or geocement compounds—analogs of natural minerals [3]. The prepared mixtures would be poured into containers set in surface casing, held until solidification, and subjected to surface decontamination.

Isolating the fuel from the fuel-containing mass prior to shipment to the storage facility will be the most complex and expensive operation of the entire processing procedure, which is why the possibility for mixing ground fuel-containing mass into geocement compounds without preliminary recovery of the fuel deserves consideration;

- building an exhaust ventilation center with dust-trapping equipment in order to rarefy the air in the receiving room. Materials and objects will unavoidably disintegrate as they are recovered, releasing a large quantity of radioactive dust into the empty spaces

of the Shelter and the receiving room. A productive, dependable exhaust ventilation system will remove dust from spaces of the Shelter and the receiving room through passages between them, and trap them with filters;

- covering openings in the Shelter facility with sheets of airtight material. This measure would increase rarefaction within it and reduce the probability of release of radioactive dust into the atmosphere;

- manufacturing an industrial robot system capable of cutting up and breaking down fuel-containing mass, large items of production equipment and structures into fragments convenient for transportation, and transporting them to the receiving room with high productivity. It could be manufactured out of dependable cutter-loaders and construction bulldozers and excavators. It would include drive engines, a travel mechanism, transmission mechanisms, a shielded cabin for the operator and the remote controls, dust suppressing and dust trapping devices, and actuators with which to break apart large structures and carry out freight-handling operations. Passages could be made between the receiving room and spaces within the Shelter by a mechanized tunnel shield. The dimensions of the passageways must allow movement of the industrial robot complex in both directions and delivery of objects and materials to the receiving room;

- after all of the construction and start-up work is completed, recovery of materials and objects from the Shelter and their processing and transfer to storage could begin. An operator recovering objects and materials with the industrial robot complex must monitor the radiation situation in the place of work, turn on the dust suppression equipment as necessary, and monitor the state of the Shelter facility's load-bearing structures. Any unstable structures discovered in the zone accessible to the actuators will need to be reinforced in order to prevent their premature collapse. After radioactive substances, materials and objects are removed from the Shelter facility, after the facility itself is dismantled and after its radioactive fragments are taken away, radioactive wastes could be removed from the imperfect storage facilities located within the 10-kilometer zone of the Chernobyl Nuclear Power Station according to a well-rehearsed industrial procedure.

Building and equipping the room in which to receive radioactive substances, materials and objects, the enterprise to process these materials, the transportation tunnels, the storage facilities for radioactive wastes, and the ventilation center, sealing off the Shelter facility, and creating the industrial robot complex are preparatory operations. Many of these operations could be started

right away, and continued in parallel. In addition all preparatory operations, including start-up operations but excluding the work of sealing off the Shelter facility, will be carried out in the absence of ionizing radiation. These two features of the proposed method, when combined with a high level of work mechanization, will significantly reduce the time needed to carry it out, make it possible to remove the Shelter facility prior to the end of its 30-year life, decrease the overall dose received by builders and personnel working to shield off the work area, and reduce the cost of one man-Sievert of prevented dose.

Comparison of the Examined Methods

Radicalness of the solution, material- and labor-intensiveness, completion time, and the overall dose received by personnel making the work area radiation-safe can serve as the criteria for comparing the methods.

The proposed method permits removal of radioactive substances, materials and objects that formed as a result of the accident. There would be direct access in the storage facility to radioactive materials and objects removed by this method. Should a container rupture during storage, it could be recovered, processed together with its contents, and returned to storage. The first of the examined methods of decontaminating the Shelter facility, by which the destroyed reactor block and spaces adjacent to it would be filled with concrete, appears equal to the proposed method in time of completion and technical complexity. Consequently the overall dose received by workers may be the same in both methods. In contrast to the proposed method, the first does not solve the problem with sufficient completeness. Consequently we would have to expect that the need would soon arise for a second phase of more material- and labor-intensive work in the presence of a radiation hazard, which will significantly increase the overall dose received in this method of decontaminating the Shelter facility.

In the proposed method, the work of removing radioactive materials and objects coincides in time with the work of maintaining the Shelter facility in an ecologically safe state. Consequently much less time will be required for it than for the second method of decontaminating the Shelter facility by preliminary erection of an additional shell. Consequently the workers will receive a significantly lower overall dose. Besides that, the labor-intensiveness of the second decontamination method is significantly greater than the labor-intensiveness of the proposed method.

The proposed method was developed with regard for two significant circumstances. 1. The exposure dose rate created by the fuel and fuel-containing mass has

now decreased significantly due to decay of short-lived radionuclides. 2. The Shelter facility may be utilized for another 20 years as a barrier preventing release of radioactive substances. Because the proposed method accounts for these circumstances, it gains a significant advantage in that all structures that will have to be built in order to carry it out will serve the same main goal—safe processing and removal of radioactive substances, materials and objects formed as a result of the accident, in compliance with all requirements. It does not foresee any secondary goals. Therefore the proposed method does not foresee construction of an additional shell over the damaged energy block or a monolithic structure. Another advantage of the proposed method is the possibility for using the processing enterprise and the radioactive waste storage facility to process and eliminate wastes from other nuclear power stations.

Conclusion

The proposed method is a safe, technically achievable and economically acceptable solution to the problem of eliminating the focus of environmental contamination at the Chernobyl Nuclear Power Station. Its result would be transfer of radioactive substances, materials and objects from the Shelter facility and of imperfect storage facilities within the 10-kilometer zone of the Chernobyl Nuclear Power Station to radioactive waste storage facilities meeting modern requirements. Storage of these wastes would become a controllable and manageable process. The Shelter facility would be eliminated.

The author acknowledges M. Y. Minashin for scientific advice and highly valuable remarks.

The author acknowledges S. N. Zelentsov, A. Ye. Inyutin, V. G. Korotkov, V. A. Reshetnikov, B. N. Teterin, F. S. Feshchenko, Yu. S. Yakushkin, Yu. P. Venediktov, V. V. Dolgov, A. A. Dubilin, A. N. Zabudko, A. A. Kutuzov, A. I. Lastov, S. S. Satin, V. L. Semenistyy and E. Ya. Smetanin for their support and remarks, and T. A. Barkov and A. A. Zhukovskaya for assistance in drafting the article.

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World's First Plant Producing Heavy Water by Two-Temperature Water-Hydrogen Sulfide Isotope Exchange

957A1033B Moscow ATOMNAYA ENERGIYA
in Russian Mar 95 No 3, pp 217-220

[Article by A. M. Rozen, All-Russian Scientific Research Institute of Inorganic Materials imeni A. A. Bochvar; UDC 66.063.2]

[FBIS Translated Text] Two-temperature water-hydrogen sulfide isotope exchange is an economical method widely used in large-scale heavy water production [1]. Plants with a productivity of 400 tonnes per year are known in Canada [2]. At the same time it was reported in the Russian press that two-temperature exchange between water and hydrogen sulfide was first carried out on an industrial scale in the Soviet Union. A large industrial plant was built during 1946-1949, and it is still operating successfully today. However, there are no references to this report in the world literature, probably because it is not supported by any specific data. The objective of this article is to present such material, and thus confirm the USSR's priority in developing this method and running it on an industrial scale.

The history of the matter is as follows. In 1945 M. I. Kornfeld approached three specialists in industrial chemical processes and apparatus—A. D. Domashnev, V. F. Kalinin and the author of this article—with a proposal to study, at the level of a request for proposal, three means of producing heavy water based on isotope exchange: stepped two-temperature water-hydrogen exchange, stepped two-temperature water-hydrogen sulfide exchange, and finally, two-column two-temperature water-hydrogen sulfide exchange. In the first two means, one step consisting of two exchangers and heat-exchange apparatus provides for only one separation coefficient; the number of steps needed to achieve significant separation are connected together into a multisteped cascade. In the two-column version (Figure 1), multisteped separation is achieved with two pieces of mass-exchange apparatus, and the scheme is fundamentally simplified. It is no surprise that our preliminary study showed the two-column method to be significantly advantageous. The scheme of the process we developed foresaw partial recuperation of the heat

fed to the gas, and conducting the process at a pressure of 10 atm, which reduced energy outlays on gas circulation (recall that if the pressure difference in the plant is ΔP , then the energy expenditure to transfer the gas is proportional to $\Delta P/P$).

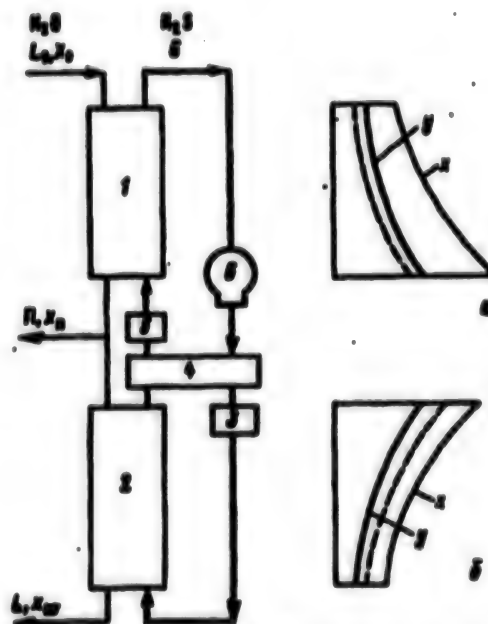


Figure 1. Schematic of a Plant Concentrating Heavy Water by Two-Temperature Hydrogen Sulfide-Water Isotope Exchange: 1,2—cold (25°C) and hot column (100°C) respectively; 3—steam heater; 4—heat exchanger; 5—refrigerator; 6—gas blower; Π —product, x_{Π} , x_w —concentration of deuterium in product and waste respectively; a,b—distribution of deuterium concentration in liquid (x) and gas (y) respectively; broken curve—equilibrium concentration of deuterium in gas y ; when $y > y_e$, in cold column, isotope absorption occurs (transfer of deuterium from gas to liquid). When $y < y_e$, in the hot column, desorption of isotope into gas occurs.

However, the physical chemistry of the process was not fully understood at that time. M. I. Kornfeld had the coefficients for the distribution of deuterium between the gas and liquid phases at two temperatures (measurements by P. Ya. Kats, L. Ya. Suvorov and P. V. Shestikin), the ratio of which in the two-temperature process β played the role of a one-time separation coefficient (more precisely, $\beta^{1/2}$), and Landau's formula for determining the overall degree of separation (L. Landau was on friendly terms with M. I. Kornfeld

and derived the formula at his request; Landau's work was not published until 1989, in the form of an ITEP [Institute of Theoretical and Experimental Physics] preprint). It followed from the formula that the degree of separation diminishes significantly (exponentially) as the ratio of the liquid and gas flows $\lambda=L/G$ deviates from some optimum value λ_0 (Figure 2). The cause of this was not understood. The opinion was even ventured during a discussion of the request for proposal that in the manner of exchangers, both columns would produce only a one-time separation effect.

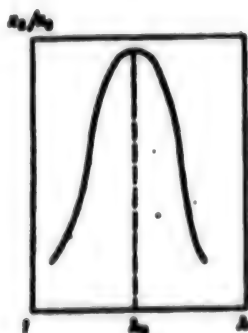


Figure 2. Degree of Separation in a Two-Temperature Apparatus as a Function of the Ratio of Liquid and Gas Flows λ , as Determined by Landau and Equations in [1,3,4]

An engineering theory of the process was needed, like the one used to describe and calculate conventional mass-exchange processes using $y-x$ (or *Tile-Makkeb* [transliteration]) diagrams (y, x —concentration of extracted substance in gas and liquid). This theory was developed by the author of this article. The process was considered as a combination of isotope absorption (the cold column) coupled with desorption (the hot column), substituting for chemical phase reversal. Correspondingly, in the cold column deuterium transfers from the hydrogen sulfide phase into water (the deuterium concentration in the gas is above equilibrium), and in the hot column it is desorbed from water into the gas phase (see Figure 1). The $y-x$ diagram of the process is shown in Figure 3 in the absence and in the presence of recovery of the concentrated product. The strong dependence of concentration on the ratio of flows λ became understandable from the diagram; the operating line of the process (the slope of which is equal to λ) turned out to be "squeezed" between the equilibrium lines, especially

in the case of product recovery. Change in λ —that is, turning of the operating line, results in a decrease in the concentration-driven pressure and a decrease in concentration. It was found that given an identical number of steps N in the hot and cold columns, the degree of separation $q=x_{11}/x_0$ (where x_{11} and x_0 are the concentrations of deuterium in the product and in the initial water) achieved with a two-temperature unit is described by the equation $q-1=[(q^0-1)(1-\theta)]\psi(\lambda)$, where $q^0=f^{1/2}$ —degree of separation without product recovery at the optimum liquid-gas flow ratio $\lambda_{opt}=(a_{100}/ba_{25})^{1/2}$ ($\beta=a_{100}/a_{25}=0.522/0.427=1.22$); $\theta=j/j_0$ —relative product recovery; $j=I/x_{11}$ —product recovery (expressed in relation to 100 percent product recovery); $j_0=Lx_0(\beta-1)/\beta$ —highest possible productivity of the unit (usually $\theta=0.8 \pm 0.05$). It is not difficult to see that the expression in the square brackets describes separation by means of rectification and any other countercurrent separation methods, if the separation coefficient is equal to $\alpha=\beta^{1/2}$. The factor $\psi(\lambda)\ln F1/chN[(\lambda/\lambda_{opt})-1]$, which characterizes the decrease in concentration in response to deviation of the liquid-gas flow ratio λ from the optimum value, reflects the unique features of the two-temperature process.

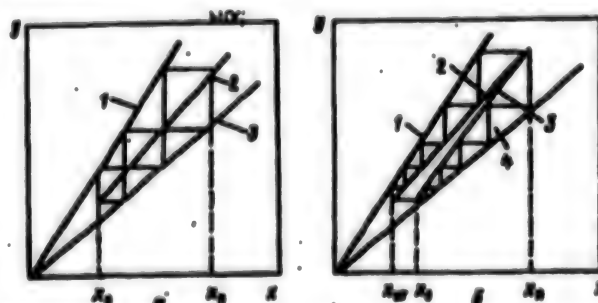


Figure 3. $y-x$ Diagram of the Process in the Absence (a) and Presence of Product Recovery in the Form of a Liquid (b): 1,3— $y_{100}, y_{25}=0.52x$ and $0.43x$, respectively the equilibrium lines for the hot (100°C) and cold (25°C) columns for an $\text{H}_2\text{O}-\text{H}_2\text{S}$ system; 2—operating line; 1,4—hot and cold column equilibrium lines; 2,3—operating lines corresponding to them

The theory made it possible to calculate the two-column process both analytically and graphically. It was reported at a meeting of the Scientific Council of the NIPKhl [Scientific Research Institute of Physical Chemistry imeni L. Ya. Karpov] in 1947, and it was not published until 1956 [3,4], though still prior to publication of the analogous theory abroad [5].

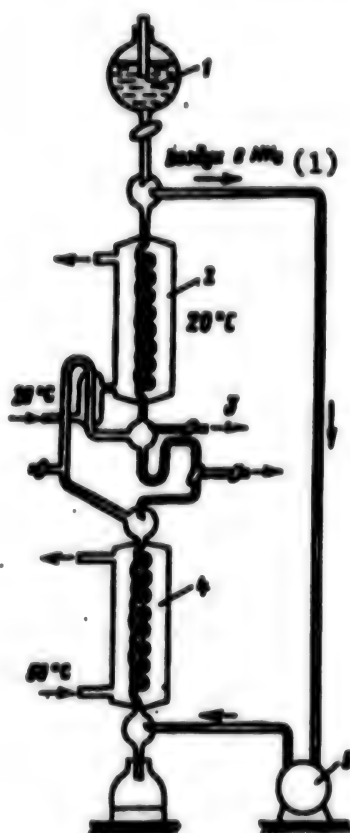


Figure 4. Two-Temperature Plant for Concentrating Ammonia Water: 1—initial ammonia water; 2—absorber; 3—sample or product recovery; 4—desorber; 5—gas blower; 6—depleted ammonia water

Key: 1—Air with NH_3

V. F. Kalinin and the author established the possibility for modeling the two-temperature process of isotope separation using nonisotopic systems as a combination of conventional absorption and desorption (such a combination is encountered in, for example, the procedure developed by S. Ye. Kalinin et al.; this means was used to concentrate sulfuric anhydride [6]). This discovery played a major role in the development of the first plant to produce heavy water by the two-temperature method. An analogous process—internal accumulation of plutonium—may occur in an extraction column owing to the combination of extraction in the uranium-free lower zone of the column and re-extraction in the upper uranium zone [7]. This possibility was realized in January-March 1946: A glass two-temperature two-column plant concentrating ammonia water was assembled (Figure 4). Air was chosen as the circulating agent

(the necessary physicochemical data were known for this system). The temperature of the absorption column was 20°C , and that of the desorption column was 50°C . The main difficulty in debugging the process was that the gas blower was not leak-tight. The contact unit—a helical film column—was characterized by low effectiveness; nonetheless, after the gas blower was made leak-tight and the operating conditions were adjusted, around three theoretical steps were achieved in each of the 700 mm-long columns (see the y-x diagram in Figure 5). As a result with regard for recovering the product in the form of samples, the degree of concentration exceeded by approximately three times the one-time effect, which was persuasive evidence of the correctness and workability of the two-temperature scheme.

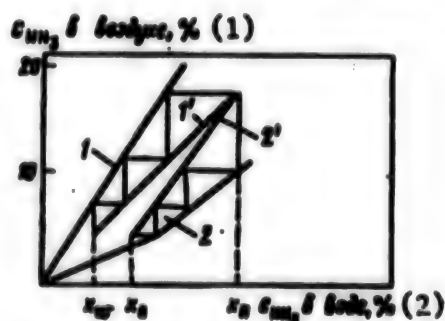


Figure 5. y-x Diagram of an Ammonia Water Concentrating Plant Using the Two-Temperature Method: 1 (50°C), 2 (20°C)—equilibrium curves of the hot and cold columns; 1', 2'—operating lines corresponding to them; x_0, x_1, x_{II} —concentration of ammonia in the initial water, waste, and product

Key: 1—in air; 2—in water

The success of the experiments was one of the most important grounds for the decision made thereafter not to check out the procedure with a semi-industrial plant, and to build an industrial unit with a productivity around 4 tonnes per year right away. The request for proposal, which was developed by V. F. Kalinin and the author, foresaw a scheme differing from that represented in Figure 1 in having heat exchangers not only in the gas but also in the liquid line, redundant gas blowers, and presence of collectors, pumps, gas handling equipment etc. After the technical proposal was approved by the ministry's Technical Council (it was then called the First Main Administration under the USSR Council of Ministers) in 1946,¹ the detail and contractor designs were drawn up by the Neftezhobdproyekt Institute (scientific director—M. I. Kornfeld, project chief engineer—T. F. Slepukh with

the participation of V. F. Kalinin, the author and R. L. Serdyuk). The production system was perfected, and detailed calculations were made of the columns, the heat exchangers and other apparatus. The column parameters were calculated using the formulas in [1,3,4], while those of the heat exchangers were calculated using known recommendations on heat transfer. (I had my doubts about the formulas for determining heat transfer during movement of gas perpendicular to the tubes and so I included a sizable margin. Start-up showed that a margin of 20 percent was sufficient.) Economically optimum heat recuperation was calculated as well (R. L. Serdyuk). The temperature of the cold column was adopted equal to 25°C, that of the hot column was 100-120°C, and pressure was 10 atm. Perforated trays providing for directed movement of liquid, known as Kittle trays [1,8], were used as the packing in both columns. What attracted us to this approach was the combination of high productivity, corresponding to 50-mm diameter Rashig [transliteration] rings, and effectiveness (the efficiency of trays located 100 mm apart was 30 percent, which corresponded to a step height of 300 mm, as opposed to 1 mm for a Rashig ring). A check of the effectiveness of 800-mm diameter trays of this design carried out under the guidance of the author of this article confirmed the system's efficiency: A figure of 27 percent was attained. Given flow rates of 100 tonnes/hr for gas and 25 tonnes/hr for the initial water and a number of theoretical steps equal to around 70, the diameter of the columns was adopted equal to 2,800 mm and height was set at 30 m; even so, this was three times shorter than in the case of producing D₂O by rectification of ammonia [8]. A gas blower with a productivity of around 100 tonnes/hr at a pressure of 10 atm and a pressure difference of 1.8 atm was developed to circulate the gas. The plant was automated.

Start-up of the plant (chief, S. L. Kukurechenko) was frustrated by mechanical problems. In particular, bolts securing the cover of the gas blower housing kept breaking due to the combined action of mechanical stresses and the gas's corrosiveness. After the mechanical problems were eliminated and all of the necessary instruments were supplied, the plant was successfully started up.

The main procedural problems were associated with precipitation of elemental sulfur and clogging of the trays of the cold column by it. Precipitation of sulfur was explained by presence of aerial oxygen, which oxidized hydrogen sulfide. Insufficient deaeration of initial water supplied for the process was one of the reasons for the presence of oxygen. Another was inleakage of air through compressors pumping hydrogen sulfide: A vacuum was generated in the cylinders during the suction stage. This cause was discovered during a visit to the plant in 1950 on the basis of experience with the same sort of inleakage plaguing a water-hydrogen isotope exchange plant created and started up under the author's leadership at the Institute of Physical Problems of the USSR Academy of Sciences. Improvement of the water's deaeration and elimination of inleakage significantly diminished precipitation of sulfur.

Operating experience showed that despite the large scale of the transition from a laboratory model (described by a glass water-air exchange plant) to a plant version (a scale factor of around 10,000 in relation to gas and liquid flows), the theoretical principles laid at the basis of the plant were quantitatively confirmed. The efficiency of the trays was an exception: Rather than 25-30 percent, it was found to be equal to 12 percent.² A scaling effect turned out to be the cause—a strong dependence of the effectiveness of trays of this design on their diameter. However, the margin adopted during planning for the number of trays made it possible to achieve eight-fold concentration in the unit.

Operation of the plant resolved one other issue that raised apprehensions during planning: It turned out that EYa-T (now Kh18N10T) stainless steel is stable in a hydrogen sulfide environment, and corrodes insignificantly.

Thereafter, for several reasons the plant worked at a reduced pressure of 7 atm in the hot column. Nonetheless, the consumption coefficients per kilogram of heavy water, calculated on the basis of operating data but with the assumption that this unit would be the first step of a two-temperature cascade and the concentration of deuterium rises by a factor of 50-100 with this method, were superior (see table).

Consumption Coefficients for Heavy Water Production by the Water-Hydrogen Sulfide Two-Temperature Method

| Characteristic | At the First Plant | At the High-Productivity Plant |
|---|--------------------|--------------------------------|
| Electric power, kWh/kg | 2,000 | 1,500-800* |
| Steam pressure, tonnes/kg: | | |
| high | 17 | 8.3 |
| low | - | 1 |
| Water (cooling), m ³ /kg | 300 | 200 |
| Cost of D ₂ O (1950 prices), rubles/kg | 1,200 | 800-600* |

*When working at a pressure of 20 atm.

Unfortunately the subsequent steps of the two-temperature cascade were not built at the plant. An experimental plant producing heavy water by a water rectification method had been built earlier on the same site in the city of Aleksin, Tula Oblast as a matter of chance. This extremely uneconomical plant, which consumes a large quantity of steam, which was expensive to produce at the indicated site, was connected as the second step. As a result the heavy water became almost 10 times more expensive (8,000 rubles/kg instead of 1,200 in 1950 prices). This delayed transition to larger two-temperature plants: Members of the Scientific Council on Heavy Water under the NIFKhI felt that a comparison of the production methods should be based on real prices. It was only after articles about large plants using the two-temperature method in the USA and Canada, for example [2], were published that this position was reconsidered. A study was conducted on a plant with a productivity of 50 tonnes/year at the level of a detail design (under the direction of I. I. Gelperin, S. Ye. Kalinin and the author of this article). The method was shown to be highly economical.

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Footnotes

1. Outstanding physicists recruited to solve the atomic problem were sometimes ignorant of the engineering side of the matter. Thus, when the author had an occasion to report the detail design to a meeting of the ministry's Technical Council, and two columns were naturally mentioned, Academician A. I. Alikhanov, who was presiding over the meeting, interrupted the report and stated in all seriousness that all of the rest was kanalizatsiya [transliteration; channeling?].

2. The plant collective later replaced the trays with sieve plates. Efficiency increased to 40 percent in the cold column and to 60 percent in the hot column. However, because the number of trays was reduced by a factor of three (the distance between trays was increased to 300 mm), the overall payoff was rather modest—1.2 and 1.8 steps per meter of height, which was far from the planned three steps.

Research on Behavior of Technological Channels of Single-Loop Boiling-Water Reactor Under Accidental Overheating Conditions

957A1032A Moscow ATOMNAYA ENERGIYA
in Russian Mar 95 No 3, (manuscript received 28 Jun 95) pp 155-160

[Article by O. Yu. Novoselskiy, V. N. Filinov and I. I. Kryuchkov, Scientific Research and Design Institute for Power Engineering; UDC 621.039.5]

[FBIS Abstract] An increase in the temperature of a fuel channel pipe in a single-loop boiling-water reactor in the event of accidental overheating causes a decrease in pipe strength and its deformation together with elements of the graphite brickwork of the reactor core. An experimental study was made of many variants of the process of accidental bulging of fuel channel pipes in models reduced by a factor of 4 and in segments of a standard Zr + 2.5% Nb fuel channel pipe with graphite units at a channel pressure up to 8 MPa, a pipe temperature up to 1,300°C and a heating rate up to 80°C/s. There is a substantial dependence of pipe rupture temperature, time before rupture and rupture deformation on pressure and heating rate. Data are obtained characterizing the rate of radial deformation of the fuel channel pipe as a function of temperature, pressure in the channel and heating rate. A series of mathematical correlations is derived, making possible formulation of a first version of a one-dimensional computation code for computing pipe deformation during accidental overheating with allowance for interaction in a definite stage of deformation with the units of the graphite moderator. Recommendations are given on more precise solution of the deformation-rupture problem, which as a minimum must be two-dimensional. Figures 5; references: 2 Russian, 1 Western.

Computational-Experimental Validation of Method for Determining Contamination Density and Penetration of ¹³⁷Cs Into Soil

957A1032B Moscow ATOMNAYA ENERGIYA
in Russian Mar 95 No 3, (manuscript received 18 Oct 94) pp 199-204

[Article by A. P. Govorun, V. I. Liksonov, V. N. Potapov, V. I. Fedin, L. I. Urutskoyev, REKOM Scientific Production Enterprise, and A. V. Chesnokov, Russian Science Center Kurchatov Institute; UDC 614.876]

[FBIS Abstract] The rehabilitation of populated places subjected to radioactive contamination after the Chernobyl accident dictated development of a method making possible a reliable determination of the density distribution of ¹³⁷Cs contamination in populated places with a spatial resolution 1-2 m. Such a method was developed: it is on-line and ensures tens of thousands of measurements during one field season. Each measurement is inexpensive and therefore the area survey is economically feasible. A method also was developed for estimating ¹³⁷Cs penetration into the soil. The detector used and its functioning are described and the computational-experimental validation of the newly developed method is outlined. On the basis of data obtained by the Monte Carlo method a physical analysis is made of the method proposed for determining the ¹³⁷Cs reserve accumulating in the soil due to its fallout as a result of such an accident. The considered method is of the field γ -spectrometry type and makes it possible to ascertain the cesium reserve after its penetration into the soil for three mean free path lengths. It is shown that it is feasible to estimate the penetration of cesium into the soil, specifically, to ascertain the thickness of the soil layer containing more than 80 percent of the entire cesium reserve. Figures 6; references 8: 7 Russian, 1 Western.

Radioactive Iodine and the 'Chernobyl Disease'

957C0021 Moscow PRIRODA in Russian Mar 94
No 3, pp 78-79

[Article by B. V. Karasev, candidate of technical sciences, All-Russian Scientific-Research Institute of Hydrogeology and Engineering Geology, Moscow]

[FBIS Translated Text] More than six years have passed since the Chernobyl accident, but its consequences are becoming increasingly felt, as was expected, unfortunately, by many who were familiar with the internal mechanisms of that tragedy. As nuclear tests have shown us, the primary radioactive threat to man has been posed by radioactive fission fragments — isotopes of iodine, the most dangerous of which is ^{131}I , which is responsible for a large part of the dose of irradiation. Once it has entered the body, iodine collects in the thyroid gland and is removed only by the ingestion of iodine compounds.

That long-lived isotope has a vigorous effect on the individual for about a month after it is formed (half-life, 8 days). Iodine exists in various forms that are highly soluble in water, one of which (elementary iodine), being volatile, evaporates and enters the body through the respiratory tract. Protection against it can be afforded by air filters only — for example, gas-mask filters with activated charcoal.

Problems associated with the radiation consequences of the Chernobyl accident have been discussed by many commissions. Most of them, however, have come to the conclusion that there is little danger of the public being exposed to radiation. Today, in the assessment of the radiation consequences, a large role is played by maps plotted on the basis of data of local testing. On those maps, isolines (or lines of equal concentration) depict regions contaminated with the most hazardous radioactive substances: cesium-137, strontium-90, and plutonium. Such cartographic materials serve as the basis for the adoption of given organizational measures, and conclusions that binding on authorities are reached concerning the cleanup of the accident. Unfortunately, there has not enough data on the iodine-131 levels during the Chernobyl accident to plot maps of its local concentrations. Obviously, despite the gravity of the problem, our services were not prepared to monitor and prevent the effects of the iodine.

Commissions for radiation testing — including the main commission of the International Atomic Energy Agency (IAEA) — have virtually ignored the danger of the radiation "iodine strike," considering its contribution relatively small. In fact, in many areas in which there was radioactive fallout, a situation developed in which the

effects of iodine-131 were not taken into consideration. In Novozybkovskiy Rayon, for example, where radioactive fallout was observed as early as 27 April 1986, the report of the IAEA commission states that it wasn't until 6 May and 7 May that the public was advised to use dry milk for children; it wasn't until 9 May that the protection and decontamination of premises were advised; and it wasn't until 17 May that children were supplied with dry milk and the public, potassium iodide. Clearly, by that time, iodine-131 was no longer the main hazard.

The data on radioactive iodine were classified, and it is only now that one can try to include such data in an assessment of the overall radiation damage.

In the meantime, as was to be expected, other, previously classified data on the consequences of the radiation effects of the Chernobyl accident began to make their way into the press. For example, according to the results of the first independent Russian-American study of the medical effects of the Chernobyl accident, the signs of acute radiation sickness were observed in the Braginskiy and Narovlyanskiy rayons of Gomel Oblast in a large number of the residents of those rayons. A typical clinical picture, according to the researchers, consists of exposure to doses of 100-400 rad. Cases with fatal outcomes were noted. Signs of chronic radiation sickness were observed in half of the children from the area with contamination levels of more than 40 Ci/km². In those rayons, adults and children both displayed symptoms of the "Chernobyl disease": complaints of asthenia, headache, dryness of the mouth, enlargement of the lymph nodes, and so forth. Cases of cancer of the larynx and the thyroid rose in all the rayons.¹

Without dwelling on the medical aspects of the problem, we shall introduce possible explanations for what was observed that are based on new studies of the radiation fallout. The first thing that catches the eye is the spottiness of the fallout at all distances from the accident site, the radioactivity of certain spots exceeding average levels tenfold. For example, we found spots of radioactive contamination by cesium-137 (as high as 5-6 Ci/km²) at the Smolensk Nuclear Power Station and the Kursk Nuclear Power Station. Since the unevenness of the fallout is one of the most important characteristics of the fallout, the maps need to indicate not only the levels of fallout (Ci/km²), but also the variation of those levels within the areas delineated by the isolines. Even larger variations are observed in living objects (plants, animals, and humans). Those variations can be allowed for if one considers that they obey one and the same universal statistical pattern: the log-normal distribution, which, in the opinion of the author, describes well many natural patterns by virtue of the fundamental causes for their appearance.² Knowing the law of variations (or, as

physicists call it, law of fluctuations) of radioactivity makes it possible predict things like the size of an area and the number of people that will be exposed to extremely high dose loads.

Our colleagues from the Scientific Production Association Tayfun (in Obninsk) analyzed iodine-131 contamination after the accident at the Chernobyl Nuclear Power Plant and ascertained the dose loads on the basis of the average values for fallout containing cesium-137 and their relationship to radioactive iodine content.³ According to those calculations, the total dose of iodine-131 in areas with cesium-137 levels of 40 Ci/km² is a bit above 26 rem (or roughly 26 roentgens, which is more understandable to many readers that have an interest in the problem). That dose corresponds fully to the provisional norm of 30 rem that was introduced by the USSR Ministry of Health as the maximum dose load for the public in contaminated areas. Thus, the calculations are formally at the limit of the established norm. That work, however, did not take into consideration the possible variations in iodine content in soils, plants, or human bodies. If one assumes that the variations in iodine content are roughly the same as those of cesium-137 that were measured by the IAEA commission and that they obey log-normal distribution, then one can estimate that nearly 2.5 percent of the public in the areas with a cesium-137 fallout density of 40 Ci/km² could have received a dose of about 300 rem!!! A dose of 400 rem is considered fatal for humans. Those estimates, despite the fact that they're approximate, explain the massive radiation injuries observed by the medical profession after the Chernobyl accident. The calculations are showing the need for a re-evaluation of many conclusions and are forcing the adoption, albeit tardy, of a number of measures to eliminate the effects threatening many residents in the contaminated areas.

Obviously, measures to mitigate the "iodine strike" must be put in place in areas in which accidents at nuclear facilities (power plants, ships with nuclear reactors, etc.) are possible: stocks of potassium iodide have been set up, a system of measures for reducing human intake of iodine has been thought out, and plans for evacuation of the public in the event of an accident have been organized.

Radioactive iodine has already done its bit to irradiate the public. The loads, supplemented now by other isotopes, are relatively small; but they are superposed on high initial doses. How can that be taken into consideration? Problems, problems, problems. The science and financial capabilities for solving those problems need to be expanded considerably.

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Mechanisms of Action of Microwave Resonance Therapy for Duodenal Ulcer

957C0010A Moscow *KLINICHESKAYA MEDITSINA in Russian* Apr 94 No 4, [manuscript submitted 12 Mar 90] pp 12-15

[Article by T.A. Zhukova, P.P. Chayalo, M.B. Chayka, Provisional Science Group Otklik, Kiev; UDC 616.342-002.44-085.849.112-036.8-07]

[FBIS Abstract] A total of 165 duodenal ulcer patients were treated with a therapeutic technique that was created by S. P. Sitko, M. U. Belyy, and Ye. A. Andreyev and is called microwave resonance therapy. The technique focuses millimeter-wavelength radiation on acupuncture points for 20 minutes daily, with the course of treatment lasting 7-10 sessions. No side effects or complications were observed. One hundred percent of patients reported the elimination of all ulcer-caused pain and dyspeptic phenomena. The course of treatment removed palpatory soreness in 89.1 percent of patients and resulted in complete healing of the ulcer within 12-14 days in 86.1 percent. Microwave resonance therapy produces a drop in the secretion of hydrochloric acid and in the activity of pepsin in stomach fluids, whereas it boosts protein concentrations by some 15 percent (seromucoid by 57 percent). The technique has a normalizing influence on blood levels of the principal gastrointestinal hormones. Figures 1, references 14: 13 Russian, 1 Western.

Combined Treatment of Duodenal Ulcers Involving the Use of High-Energy Laser Radiation

957C0010B Moscow *KLINICHESKAYA MEDITSINA in Russian* Apr 94 No 4, [manuscript submitted 16 Mar 94] pp 15-16

[Article by V. B. Matyushichev, A. I. Soldatov, Scientific Research Institute of Physiology imeni A. A. Ukhomskiy, St. Petersburg University; Baltic Central

Basin Hospital imeni G. I. Chudnovskiy; UDC 616.342-002.44-085.849.19]

[FBIS Abstract] A total of 316 duodenal ulcer patients were treated in a regime involving endoscopic laser therapy (copper-vapor laser source) and pharmacotherapy (administration of, for example, antacids, vitamins, H₂-histamine receptor blockers, spasmolytics, or tranquilizers). The patients—separated into four groups based on laser wavelength—underwent the laser therapy every other day. Rapid clinical remission of exacerbation was noted in the patients during the therapy. Reliable elimination of pain required only one or two sessions of therapy in most cases. Mucosal defects were healed without any noticeable deformation of the intestinal wall. The ulcers in 96 percent of the patients cicatrized within four weeks, as opposed to the normal period of three or four months with pharmacological therapy alone. Green-and-yellow laser light produced the best results, eliminating the ulcers within an average of 11-12 days. In general, patients healed twice as fast as did those in the control group (pharmacological therapy alone). References 9: 7 Russian, 2 Western.

Need for Family Doctors for Rural Population of Turkmenistan

957C0007 *Ashgabat ZDRAVOOKHRANENIYE TURKMENISTANA in Russian No 2, Mar-Apr 94 pp 3-5*

[Article by A. T. Atayeva, A. A. Kalinskaya, Kh. P. Omarov; UDC 616-058+362.141]

[FBIS Abstract] One means of improving the health care system in Turkmenistan is to gradually introduce family medicine and the family or general-practice doctor. A number of facts point to the need for such a change, one being the high infant mortality rate in Turkmenistan. The researchers here set out to substantiate the need for family medicine, especially in rural areas, by examining records at the Sayat Rural Administrative Etrap of the Lebapsk Velayat, whose population numbers 41,000. It was established that 6,617 of the total number of visits per 1,000 population (8,800) could have been handled by family doctors, with the remaining 2,183 handled by specialists. Some 2,800 visits per 1,000 population for preventive purposes could have been handled by family doctors. The researchers postulate that one family doctor would serve 100 families, or 820 individuals. Family medicine holds promise for the rural population of Turkmenistan because of sociodemographic and medical-organizational features of that population, such as the high birth rate, the prevalence of large families, the high child mortality rate, and customs that hinder prompt hospitalization.

Introduction of Biotin Labels Into Single-Stranded DNA Without Knicking of Internucleotide Bonds

957A0234A *Moscow BIOORGANICHESKAYA KHIMIYA in Russian (manuscript received 3 Mar 93; final draft 11 Nov 93) Vol 20 No 5, May 94 pp 515-523*

[Article by M. I. Dobrikov, T. A. Prikhod'ko, I. V. Safronov and G. V. Shishkin; Novosibirsk Institute of Bioorganic Chemistry; Siberian Department; Russian Academy of Sciences UDC 577.113.4]

[FBIS Abstract] An attempt to increase the degree of biotinylation of single-chain DNA without significant degradation of the polydesoxynucleotide chain and with preservation of hybridization properties involved a comparison of properties of biotinylated M13 single-stranded DNA obtained with the use of photoreagents: N-methyl-N-[3-(4-azidobenzoylamino)propyl]-1,3-propylenediamine (I), N-methyl-N-[3-(2-nitro-5-azidobenzoylamino)propyl]-1,3-propylene diamine (II) and chemical reagents glutamic acid gamma-hydrazide (III), O-(4-aminobutyl)hydroxylamine (IV) Biotin residue was introduced by subsequent acylation of modified DAN by N-hydroxysuccinimide ester of N-biotinylaminocaproic acid. Use of photoreagent (I) made it possible to introduce up to 15 residues of biotin per 1000 nucleotides (15 bio/kN) and use of photoreagent (II) permitted introduction of 3-5 bio/kN. In both cases, there was degradation of the single-chain DNA M13. Transamination with the use of reagents (III) and (IV) in the presence of bisulfite produced bio-single DNA M13, bearing 4-30 bio/kN. Conditions for conducting the reaction precluded destruction of the single-stranded DNA M13 and hybridization properties were preserved Figures 2; references 22: 10 Russian; 12 Western.

Expression of Gene Coding for D1 Protein of Barley Photosystem II in *Escherichia coli*

957A0234B *Moscow BIOORGANICHESKAYA KHIMIYA in Russian (manuscript received 5 Apr 93; final draft 29 Nov 93) Vol 20 No 5, May 94 pp 524-535*

[Article by V. A. Efinov, S. V. Reverdatto, V. A. Beylinson, A. F. Fradkov and O. G. Chakmakheva; Institute of Bioorganic Chemistry imeni M. M. Shemyakin and Yu. A. Ovchinnikov; Russian Academy of Sciences; Moscow] UDC 577.217

[FBIS Abstract] Plasmids guiding expression of D1 protein of photosystem II of barley were constructed. The fundamental possibility of expression of psbA in the eukaryotic system in vitro was demonstrated and strains of *E. coli*, producers of protein D1, were obtained for the first time. These steps created preconditions for

producing, in bacteria, mutant forms of protein D1, resistant to the effect of herbicides and for the study of their physical and chemical properties. Figures 4; References 25: 6 Russian; 19 Western.

Primary Structure of Polyhedrin of Nuclear Polyhedrosis of Lackey Moth *Malacosoma neustria* (L).

957A0234C Moscow BIOORGANICHESKAYA
KHIMIYA in Russian (manuscript received 13 Dec 93)
Vol 20 No 5, May 94 pp 543-545

[Article by E. A. Kozlov, N. V. Rodnin, L. I. Pal'chikovskaya, T. L. Levitkina et al; Institute of Molecular Biology and Genetics; Ukrainian Academy of Sciences; Kiev] UDC 577.112.5:578.841

[FBIS Abstract] The primary structure of *M. neustria* nuclear polyhedrosis virus was determined on the basis of protein chemistry. The protein was reduced, carboxymethylated and decomposed by trypsin. The peptides were separated by gel-filtration, high-voltage electrophoresis and paper chromatography as described for other polyhedrons. Large tryptic peptides, containing more than 10 residues of amino acids were split by chymotrypsin and thermolysin and the peptides obtained were separated by electrophoresis and paper chromatography. Sequencing was conducted by the Edman method. The polypeptide chain of *M. neustria* polyhedrin was reconstructed by comparing the peptides obtained with amino acid sequences of polyhedrins of other nuclear polyhedrosis viruses, established in the laboratory. These included *Bombyx mori*, *Porthetria dispar*, *Galleria mellonella*, *Agrotis segetum* and *Maestra brassicae* nuclear polyhedrosis virus polyhedrins. Figures 2; References 10: 6 Russian; 4 Western.

Expression of Fragment of *Torpedo californica* Acetylcholine Receptor α -subunit Gene in *Saccharomyces cerevisiae*

957A0234D Moscow BIOORGANICHESKAYA
KHIMIYA in Russian (manuscript received 15 Dec 93)
Vol 20 No 5, May 94 pp 546-550

[Article by O. V. Telyakova, Yu. N. Utkin, V. I. Tselin, I. V. Severtsova and N. M. Zvonok; Institute of Bioorganic Chemistry imeni M. M. Shemyakin and Yu. A. Ovchinnikov; Russian Academy of Sciences; Moscow] UDC 577 (214+217)

[FBIS Abstract] Production of a fragment of an α -subunit of acetylcholine receptor of *Torpedo californica*, consisting of a ligand-binding section and transmem-

brane domains M1 and M2 was described and discussed. Such construction may be a convenient model for study of the structural-functional organization of the acetylcholine receptor. Expression of the appropriate section of the gene of A-subunit of the acetylcholine receptor was performed in *S. cerevisiae*. Translation termination codons in all frames were inserted as part of a self-complementary oligodeoxynucleotide to the Eco47III site. Vector pJDach was constructed by cloning the expression cassette between the BamHI and HindIII sites in the multicopy yeast plasmid pJDB207. Yeast cells harboring the pJDach vector produced mainly an N-glycosylated fragment of the acetylcholine receptor α -subunit, detected by means of [¹²⁵I]- α -bungarotoxin. The fragment's location in the membrane fraction after disruption of the yeast cells simplified its isolation. Figures 3; references 31 (Western)

Receptors of Selectins. I. Synthesis of Tetrasaccharides SiaLe² and SiaLe^x and Their Polymer Conjugates

957A0234E Moscow BIOORGANICHESKAYA
KHIMIYA in Russian (manuscript received 17 Nov 93;
final draft 7 Feb 94) Vol 20 May 94 pp 551-555

[Article by N. E. Nifant'yev, Yu. Ye. Tsvetkov, A. S. Shashkov; A. B. Tuzikov et al; Institute of Organic Chemistry imeni N. D. Zelinskiy; Russian Academy of Sciences; Moscow; Institute of Bioorganic Chemistry imeni M. M. Shemyakin and Yu. A. Ovchinnikov; Russian Academy of Sciences; Moscow] UDC 547.458.41.057

[FBIS Abstract] Study of the precise specificity of selectins, their appearance on the cell membrane, study of processes of expression, clustering, interaction with receptors and, finally, shedding may most accurately and reliably be conducted by use of synthetic receptors of selectins. Tetrasaccharides SiaLe² (9) and SiaLe^x and their polyacrylamide conjugates (1a-b) and (2a-b) were synthesized for this purpose. Condensation of the spacers tetrasaccharides with poly(4-nitrophenylacrylate) yielded N-substituted polyacrylamide-type polymers. Biotinylated probes and polymers modified by phosphatidylethanolamine (strong immunogens) were also obtained. The unsubstituted and labelled polymeric derivatives were used to study selections and other lectins and for production and epitope characterization of monoclonal antibodies against sialooligosaccharides. Understanding of the mechanism of selectin-mediated interaction may help in development of a new generation of medicines, acting on the principle of inhibition of intracellular adhesion. References 11 (Western)

Receptors of Selectins. 2. Synthesis of $\text{HSO}_3\text{-3'Le}^a$ — Sulfated Ligand of Cell Adhesion Molecule, E-Selectin

957A0234F Moscow BIOORGANICHESKAYA KHIMIYA in Russian (manuscript received 28 Jan 94 Vol 20, May 94 pp 556-559)

[Article by T. V. Zemlyanukhina, N. Ye. Vifantiyeva, L. O. Kononov, A. S. Shashkov and N. V. Bovin; Institute of Bioorganic Chemistry imeni M. M. Shemyakin and Yu. A. Ovchinnikov; Russian Academy of Sciences; Moscow; Institute of Organic Chemistry imeni N. D. Zelinskiy; Russian Academy of Sciences; Moscow] UDC 547.458.3.057

[FBIS Abstract] Chemical synthesis of the trisaccharide $\text{HSO}_3\text{-3'Le}^a$, containing a spacer grouping convenient for further immobilization, was described and discussed. Selective substitution of 2,3-diole grouping of the galactose link was tested for introduction of the sulfate. Benzylidene derivative (Ia) was used as a model compound. Coupling of the aminopropyl glycosides with poly (4-nitrophenylacrylate) produced polyacrylamide conjugates with bitoinylated probes of the Sug-PAA-biotin type being obtained as well. References 19 (Western)

EEG Reflection of Extrasensory Influence

957C0028 Moscow FIZIOLOGIYA CHELOVEKA in Russian Vol 20, May-Jun 94 [manuscript submitted 12 May 93] pp 36-44

[Article by N. K. Blagosklonova, A. N. Gusev, Yu. M. Koptelov, S. A. Shapkin, Institute of Correction Pedagogy, RAO; Moscow State University imeni M. V. Lomonosov; Medical-science firm MBN; Institute of Psychology, Russian Academy of Sciences, Moscow.; UDC 612]

[FBIS Abstract] Techniques for analyzing the bioelectrical activity of the brain are accepted methods for studying changes in the functional state of the individual and can be used as an objective indicator of influences exerted on the individual. Researchers here studied nine psychic/test-subject pairs to determine whether the psychics are able to affect the EEGs of the test subjects. They found that, in most cases, changes were produced in the EEGs, with the changes usually taking the form of elevated synchronization of electrical activity, as well as surges in the α - and θ ranges, primarily in the anterocentral regions of the cortex, which are projection areas of the mesodiencephalic sections of the brain. Functional,

as well as organic, disturbances of the mesodiencephalic structures can produce the kinds of EEG changes observed. The presence of the θ -rhythm in the anterocentral regions could also be associated with disturbances of the emotional sphere and can be found in healthy individuals during elevated activity of the brain structures such as the hippocampus and hypothalamus. The researchers postulate that it could have been those structures that were activated in the test subjects during sessions in which the psychics, in the same room with the test subjects, were attempting to exert an extrasensory influence on the subjects. The researchers also found that changes appeared in the EEGs when the psychics were in separate rooms, i.e., elevated synchronization of the cortical rhythms in the α and θ ranges, which could indicate elevated activity of the synchronizing structures of the thalamus. Figures 4, references 13: 9 Russian, 4 Western.

'Host-Conditionally Pathogenic Protozoa' System. Dissemination of Infection by *Leishmania Infantum* in Naturally Susceptible Laboratory Animals Subjected to Medicamental Immunosuppression

957A0480 St. Petersburg PARAZITOLOGIYA in Russian (manuscript received 10 Jun 93) Vol 28 No 4, Jul-Aug 94 pp 293-297

[Article by F. P. Kovalenko, A. Ya. Lysenko and M. V. Lavdovskaya; Institute of Medical Parasitology and Tropical Medicine imeni E. I. Martynovskiy; Russian Medical Academy of Graduate Education; Ministry of Health; Russian Federation] UDC 576.893.161.13:599.32

[FBIS Abstract] A study of the effect of medicamental immunosuppression on reactivation and dissemination of *L. infantum* infection involved infection of 212 laboratory animals (53 23-49 g soft-furred rats, 20 78-157 g hispid cotton rats and 139 32-119 g golden hamsters). Short-term action (hydrocortisone, metipred) and long-term action (tricot-40) drugs were injected subcutaneously at the time of infection by *L. infantum*. The drugs caused reproduction of disseminated Leishmaniosis infection. *Leishmaniae* appeared only in the target organs in the absence of immunosuppression. Hydrocortisone and metipred promoted moderate dissemination of the parasites only in the lungs while tricot-40 caused dissemination also into the host kidneys and testes. The length of survival of the animals with experimental leishmaniosis did not differ from that in control animals. References 15: 4 Russian; 11 Western.

Purification and Characteristics of *Listeria Monocytogenes* Listeriolysin O

957A0171A Moscow *ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLOGII* in Russian (manuscript received 19 Feb 92) No 4, Jul-Aug 94 pp 3-7

[Article by L. A. Karpova, Yu. F. Belyy, I. S. Tar-takovskiy and S. V. Prozorovskiy; Scientific Research Institute of Epidemiology and Microbiology imeni N. F. Gamaleya; Russian Academy of Medical Sciences; Moscow]

[FBIS Abstract] A procedure for purifying listeriolysin O produced by *L. monocytogenes* strain NCTC 7973 was described and discussed. The procedure involved cultivation of the bacteria in the art-brain broth, precipitation of the fraction by ammonium sulfate with subsequent ion-exchange chromatography on CM-Sepharose 6B and "Mono S" columns and gel-chromatography on a Superose-12 column. SDS electrophoresis showed the material obtained to be homogenous. The preparation obtained did not differ in physico-chemical properties from previously studied protein and had characteristics similar to those of thiole-dependent hemolysins. The purified protein had a molecular weight of 60 kd, was sensitive to the effect of proteolytic enzymes and thiole compounds and cholesterol. Figure 1; references 14: 1 Russian; 13 Western.

Gas Chromatographic Analysis of Fatty Acid Composition of *Yersinia Pestis*

957A0171B Moscow *ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLOGII* in Russian (manuscript received 11 Jun 92, final draft 21 Jan 93) No 4, Jul-Aug 94 pp 10-13

[Article by V. M. Samygin, L. F. Zykin, V. M. Stepanov, A. A. Stepin and I. I. Korsakova; Volgograd Scientific Research Institute; Central Asia Scientific Research Anti-plague Institute; Almaty]

[FBIS Abstract] A study of features of the fatty acid composition of *Yersinia pestis* bacteria strains used museum collections and cultures isolated in natural foci of Russia in Taukumsk and Muyunkumsk. The bacterial cells contained high quantities of methylenehexadecanoic acid, palmitic acid, oleic acid with elaidic acid, palmitoleic and pentadecanoic acid. They also contained some lauric acid, myristic acid, 3-oxymyristic acid and m ethyleneoctadecanoic acid. Fatty acid composition of two strains grown at 28 and 37 degrees C on solid and liquid nutrient media remained qualitatively unchanged but the concentration of saturated fatty acids on the solid medium increased with the increase of temperature and increase of time of growing the cells. Vac-

cine strains, museum strains and newly isolated strains differed in antigenic structure but were the same in fatty acid composition. Figure 1; references 13: 11 Russian; 2 Western.

Cloning and Expression of Phospholipase D Gene From *Corynebacterium Psuedotuberculosis*

957A0171C Moscow *ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLOGII* in Russian (manuscript received 27 May 92) No 4, Jul-Aug 94 pp 24-28

[Article by A.V. Dmitriyev, Irzhi Smola, Klaas Shalen, V. I. Golubkov and A.A. Tomolyan; Institute of Experimental Medicine; Russian Academy of Medical Sciences; St. Petersburg; University of Veterinary Sciences; Brio. ChSFR; Institute of Medical Microbiology, Lund, Sweden]

[FBIS Abstract] Gene pld, which codes synthesis of phospholipase D (PLD) *Corynebacterium pseudotuberculosis*, was cloned using Bluescript II SK⁺ as a vector with subsequent stable and active expression of the enzyme in *E. coli*. The DNA fragment cloned in *E. coli* was about 2.8 kb in size. The molecular weight of the PLD synthesized in *E. coli* was about 31 kD. The gene engineered PLD had the biological activity of the natural product. It caused hemolysis of sheep erythrocytes in the presence of *Rhodococcus equi* and suppressed hemolytic activity of staphylococcal beta-hemolysin (phos pholipase C). Figure 2; references 13: 1 Russian; 12 Western.

Epidemiological Characteristics of Single Cases of Campylobacteriosis in Urban Inhabitants

957A0171D Moscow *ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLOGII* in Russian (manuscript received 26 Jun 92) No 4, Jul-Aug 94 pp 32-35

[Article by V. I. Minayev, T. N. Nikolayeva, V.N. Smirnov, I. A. Litvinov et al; Central Scientific Research Institute of Epidemiology GKSEN; Russian Federation; Moscow; Vologda Regional Sanitary Epidemiology Station]

[FBIS Abstract] Bacteriological study of 103 hospital patients with acute intestinal infections in 1989 and study of 50 patients with acute intestinal infections in 1991 showed an increase of campylobacteriosis among the persons studied from 2.9 percent to 8.0 percent and showed a great increase of bacteria carriers among healthy persons (4.4 percent). The basic source of the infection was poultry farm chickens. Poultry farm workers made up 8.6 percent of the infection carriers. Morbidity from *Campylobacter* infection in Vologda, involving

individual cases, had an epidemic nature. The intensive epizootic process among chickens and the absence of effective measures of specific prophylaxis requires implementation of a complex system of hygienic measures to alleviate the situation. References 15: 12 Russian; 3 Western.

Extent of Etiological Forms of Viral Hepatitis in Khabarovsk

957A0171A Moscow *ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLOGII* in Russian (manuscript received 25 Mar 92) No 4, Jul-Aug 94 pp 35-38

[Article by O. E. Trotsenko, V. V. Bogach, M. V. Karepina and L. I. Yuzhakov; Scientific Research Institute of Epidemiology and Microbiology; Khabarovsk]

[FBIS Abstract] In 1990-1991 in Khabarovsk, 1,505 persons with viral hepatitis, ranging in age from one year up to 60 years were observed. The observation was divided into two periods: epidemic and interepidemic. The leading etiological form of viral hepatitis was hepatitis A. Incidence of hepatitis A was much greater in the children than in the adults and its spread was greater than that of hepatitis B and undifferentiated hepatitis. Hepatitis B was found more frequently in adults than in children while incidence of undifferentiated hepatitis was practically the same in children and adults. The ratio between etiological forms of viral hepatitis was determined by the epidemic situation. Hepatitis A increased in the epidemic period and incidence of hepatitis B decreased. The reverse was true in the inter-epidemic period. Undifferentiated hepatitis appeared with equal frequency in different periods of observation. Figure 1.

Study of Activity of Natural Killers and Killer Cells in Mice Vaccinated Against Plague

957A0171F Moscow *ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLOGII* in Russian (manuscript received 10 Dec 91) No 4, Jul-Aug 94 pp 42-44

[Article by Ye. V. Solokhin, S. Yu. Pchelintsev, S. V. Yurov, V. I. Urayeva et al; Institute of Immunology of State Concern "Biopreparat" Lyubuchany; Moscow Oblast]

[FBIS Abstract] Studies were performed on 236 12-14 g CBA mice vaccinated against plague. Vaccination by different doses of the vaccine strain of *Yersinia pestis* EV led to dose-dependent reaction of the killer-cells. On the 28th day after vaccination, K-cell activity increased after use of large doses of the vaccine while natural killer activity increased on the third day after low doses. Natural killers activity decreased on the 14th-

28th day after immunization by all doses of vaccines used. Maximum concentration caused suppression for a longer time. Suppression of natural killer activity was attributed to immunological reconstructions associated with immunization by *Y. pestis* EV. References 9: 6 Russian; 3 Western.

Effect of Recombinant Interleukin-1B on Reaction of Lymphocytes Induced by Concanavalin A

957A0171G Moscow *ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLOGII* in Russian (manuscript received 5 Dec 91; final draft 6 Apr 92) No 4, Jul-Aug 94 pp 69-72

[Article by Yu. V. Zakrevskaya, G. N. Semenkova, P. P. Murzenok, S. N. Cherenkevich and V. N. Gurin; Belorussian State University, Minsk]

[FBIS Abstract] A study of the effect of interleukin-1b at different stages of activation of lymphocytes showed that incubation of human peripheral blood lymphocytes with recombinant interleukin-1b increased the rates of generation of active forms of oxygen and agglutination of cells at the initial stages of effect of Con A. The effects of recombinant interleukin-1b was most pronounced at concentrations of lymphokine at 15-20 EA/ml. Recombinant interleukin-1b amplified proliferative response of mouse thymocytes to the effect of Con A. Figures 2; references 14: 11 Russian; 3 Western.

Preventive Properties and Therapeutic Effectiveness of Anti-tetanus Immunoglobulin for Intravenous Injection in Experiment

957A0171H Moscow *ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLOGII* No 4 Jul-Aug 94 pp 81-84

[Article by V. S. Sapozhnikova and I. M. Dumkin; Scientific Research Institute of Hematology and Blood Transfusion; Kirov]

[FBIS Abstract] A new antitetanus immunoglobulin for intravenous injection, developed at the Kirov Scientific Research Institute of Hematology and Blood Transfusion, uses the method of acidic fermentative hydrolysis. The drug possesses great potential in tetanus treatment. Use of the preparation within 30 minutes of infection of animals completely neutralized the effect of tetanus toxin. Injection within 24 hours from onset of tetanus saved all animals from death and eliminated clinical signs of tetanus in 50 percent of them. Intramuscular injection of the drug in a maximum dose produced a prophylactic effect but no pronounced therapeutic effect. The preparation has high specific potency. One

dose contains at least 1,500 I.U. of tetanus antitoxin. References 15: 9 Russian; 6 Western.

Thymosin alpha and Hybrid Proteins Consisting of Tumor Necrosis Factor alpha and Thymosin alpha Increase Effectiveness of Vaccination Against Plague Pathogen

957A01711 Moscow *ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLOGII* in Russian (manuscript received 8 Jun 92) No 4, Jul-Aug 94 pp 85-89

[Article by V. A. Shmelev, B. V. Grigor'yev, T. I. Mozharova and S. G. Popov; Scientific Research Institute of Microbiology; Obolensk; Moscow Oblast]

[FBIS Abstract] A study of the effect of thymosin alpha and hybrid proteins consisting of tumor necrosis factor alpha and thymosin alpha on effectiveness of vaccination against *Yersinia pestis* showed that chemical thymosin alpha produces an immunomodulating action, amplifying specific antimicrobial immunity caused by the vaccine strain of *Y. pestis* EV 76 on models of white mice and guinea pigs. Recombinant thymosin alpha affected restoration of the immune system of white mice after sublethal doses of gamma-irradiation. Hybrid proteins consisting of thymosin alpha and tumor necrosis factor alpha amplified specific immunity in different courses of the vaccine process against the plague pathogen after different methods of infection on models of white mice and guinea pigs. The highest effectiveness and reproducibility of results came from the use of hybrid protein T thymosin-tumor necrosis factor-thymosin. References 22; 3 Russian; 19 Western.

Sorbed Immunoglobulins of Animals — Reserve for Increasing Output of Therapeutic Antitoxic and Diagnostic Sera

957A0171J Moscow *ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLOGII* in Russian (manuscript received 27 May 92) No 4, Jul-Aug 94 pp 96-100

[Article by B.B. Pershin, S.N. Kuz'min and N. N. Filatov; "Immunoprophylaxis" Center; Russian Academy of Medical Sciences; Moscow]

[FBIS Abstract] A study of the fundamental possibility of producing additional (to the content in the blood serum) quantities of immunoglobulins and specific antibodies during production of therapeutic antitoxic and diagnostic sera of animals showed this to be possible by means of their desorption from the surface of formed elements of the blood. Desorbed immunoglobulins and specific antibodies may be used in production of therapeutic and diagnostic immunobiological preparations.

This could be achieved, in principle, without increasing the number of producer animals. References 6: 1 Russian; 5 Western.

Prospects of Creating Unified System of Immunoprophylaxis of Wound Clostridiosis

957A0171K Moscow *ZHURNAL OF MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLOGII* in Russian (manuscript received 6 Apr 92) No 4, Jul-Aug pp 111-116

[Article by T. I. Sergeyeva; Scientific Research Institute of Epidemiology and Microbiology N. F. Gamaleya; Russian Academy of Medical Sciences; Moscow]

[FBIS Abstract] The importance of developing a system and means of immunoprophylaxis of gas gangrene are determined by several factors: epidemiological, clinical-pathogenetic and military-medical. Epidemiological aspects of gas gangrene were discussed and the incidence, and causes in peacetime were discussed using clinical-pathogenetic aspects. The likelihood of use of "traditional" weapons in future wars calls for a unified system of immunoprophylaxis of clostridiosis. Since there is still no immunogenic preparation developed with consideration of the etiopathogenesis of the infection process, the nature of the immune response and tactics of use of this preparation, research into these matters is paramount. A diagram of immunoprophylaxis of gas gangrene was presented and discussed. It included one approach to planned active immunization and one approach to emergency immunoprophylaxis. References 30: 21 Russian; 9 Western.

Activation of Human Adaptive Mechanism as a Way To Improve Health

957A0989A St. Petersburg *VESTNIK SANKT-PETERBURGSKOGO UNIVERSITETA. SERIYA 3 BIOLOGIYA* in Russian Issue 4 No 4, Nov 94 pp 82-92

[Article by V.P. Galantsev, T.N. Baranova, L. P. Pavlova, I. N. Yanvareva; submitted 15 Apr 94; UDC 612.017.2:612.821]

[FBIS Abstract] A study was performed to develop new methods for express diagnosing the functional condition (FC) of the brain and human adaptive potential and enhancing the body's general resistance to stress. The study was carried out on 75 healthy individuals of both sexes of various ages (7-70) and levels of fitness. Thirty students under observation by the university's clinic due to psychologically induced intellectual impairments were also used in the study. An original method patented by the authors, which simulates the adaptive responses of diving aquatic mammals to exposure

to cold and hypoxia (CHE), was used to study the adaptive responses of the human cardiovascular system to CHE. The method essentially involves immersing the subjects' faces in water of various temperatures and then measuring their EKG and EEG responses. It was found that the cardiovascular adaptive response to cold and hypoxia depends on age, physical fitness, and individual characteristics. A three-phase process was observed for normalization of the FC of the brain, defined by the strength and coherence of the alpha rhythm after immersion. Within the parameters of the patented method used in this study, the body's response(s) to CHE allows brain and cardiovascular activity to quickly normalize after physical stress, eliminates some types of cardiac arrhythmia, and relieves stress. These effects are associated with increased circulation to the brain and heart. It was shown that even a one-time exposure to the combined effects cold and hypoxia has a positive effect on the shift in the body's FC. This formed the basis for a program to stimulate development of the adaptive mechanism. After two weeks of daily CHE sessions, increases were observed in the R-R interval in the subjects' EKGs. Figures 4; references 16: 11 Russian, 5 Western.

Synthesis of Benzimidazole Derivatives and Their Effects on the Membrane Toxic Effects of Organophosphorus Compounds

357A1061A Moscow

KHIMIKO-FARMATSEVTICHESKIY ZHURNAL
in Russian Dec 94 No 12, pp 26-28

[Article by V. A. Myshkin, V. A. Katayev, Z. G. Khaybullina, V. M. Dianov, A. F. Vakaritsa, F. A. Khaliullin, S. A. Bashkatov, E. G. Davletov, Ye. E. Klen and A. N. Krasovskiy, Bashkir Medical Institute, Ufa; UDC 615.272.014.425].012.1]

[FBIS Translated Text] Recent research shows that it is fundamentally possible for some anticholinesterase organophosphorus compounds (OPC) to act according to the free-radical mechanism; this research also indicates a certain selectivity of this mechanism in relation to different organophosphorus compounds [2,4,5,13]. According to some information, lipid peroxide oxidation inhibitors may be used to raise the effectiveness of antidotes to organophosphorus compounds [2,4,6,13]. Development of this direction presupposes screening new antioxidants as potential OPC antagonists. Research in [1] established the membrane-stabilizing effect of benzimidazole derivatives, and their advantages over known antioxidants were demonstrated.

The goal of this research was to synthesize new antioxidants in the benzimidazole derivative series, and to

study their effectiveness as agents of pharmacological correction of the membrane-toxic effects of OPC.

Alkylation of 1-methyl-2-mercaptobenzimidazole (Ib) by 3,4-dihydroxyphenacylchloride in an alcohol medium produced 2-(3,4-dihydroxyphenacylthio)-1-methylbenzimidazole (IIb). Its structural analog, 2-(3,4-dihydroxyphenacylthio)benzimidazole (IIa), was synthesized according to the procedure in [7]. The derivative of thiazolo[3,2-a]benzimidazole (III) was obtained by cyclization of compound IIa by heating in phosphorus oxychloride.

[Formula omitted in original; caption reads: I, II: R=H(a), Me(b).]

Methyl and methylene group singlets were discovered in the paramagnetic resonance spectrum of compound IIb in addition to an aromatic proton multiplet. The characteristic absorption bands of hydroxyl and carboxyl groups in the IR spectrum also confirm the structure of compound IIb. Absence of NH- and CO-group absorption bands in the IR spectrum is evidence of the cyclic structure of compound III.

The initial product used for synthesis of 2-substituted 1-(thiethanyl-3)benzimidazole is 1-(thiethanyl-3)-2-chlorobenzimidazole (IV). The compound 2-propoxy-1-(thiethanyl-3)benzimidazole (Va) was obtained by boiling compound IV in PrOH in the presence of PrONa. Interaction of compound IV with an equimolar quantity of thiourea in ethanol medium leads to formation of 2-mercapto-1-(thiethanyl-3)benzimidazole (Vb).

[Formula omitted in original; caption reads: V: X=OPr(a), SH(b).]

The PMR spectrum of compound Va contains multiplets representing protons of the aromatic ring and a thiethane ring [9], as well as signals representing protons of a propoxy group: methyl and oxymethylene group triplets, and a methylene proton multiplet. The IR spectrum of compound Vb confirms presence of the mercapto group (a characteristic absorption band at 2,570 cm⁻¹).

Experimental Chemistry

The IR spectra of the synthesized compounds were recorded with a Beckman 620 MX instrument in a petroleum jelly suspension, and PMR spectra were recorded with a Tesla BS 567 instrument (100 MHz) in trifluoroacetic acid, using t₄MDS internal standard. The individuality of the compounds was determined by the TSKh [not further identified] on Silufol plates in a butanol-AcOH-water (4:1:2) system, developed in iodine vapor. Data of elemental analysis for C, H, N and S content are consistent with calculations.

2-(3,4-Dihydroxyphenacylthio)-1-methylbenzimidazole (IIb). A solution of 0.82 gm (5 millimoles) of 1-methyl-2-mercaptobenzimidazole and 1.0 gm (5.4 millimoles) of 3,4-dihydroxyphenacylchloride in 30 ml ethyl alcohol is boiled for 8 hours. It is cooled to 10°C, and the precipitate is filtered, dissolved in water and neutralized with sodium carbonate. This produces 0.7 gm (45 percent) of compound IIb. Melting point—232-234°C (ethanol-DMPA, 3:0.5). PMR spectrum, δ , m.d.: 3.65 (3H, c, CH₃), 4.56 (2H, c, CH₂), 7.09-7.42 (7H, m, arom. H). IR spectrum, ν_{max} , cm⁻¹: 2856-3128 (OH), 1660 (CO).

3-(3,4-Dihydroxyphenyl)thiazolo[3,2-a]benzimidazole (III). A mixture of 10 gm (33 millimoles) of compound IIa and 50 ml of phosphorus oxychloride is boiled for 1 hour. Phosphorus oxychloride is distilled away under a vacuum, and the residue is decomposed with ice and neutralized with sodium carbonate. This produces 8 gm (86 percent) of compound III. Melting point—229-231°C (DMPA). IR spectrum, ν_{max} , cm⁻¹: 2856-2928 (OH).

2-Propoxy-1-(thiethanyl-3)benzimidazole (Va). 0.28 gm (12 millimoles) Na and 2.25 gm (10 millimoles) of compound IV are dissolved in 50 ml PrOH and boiled for 3 hours. The solution is cooled and filtered, and the filtrate is boiled down. This produces 1.7 gm (69 percent) of compound Va. Melting point—51-54°C (ethanol-water, 1:1). PMR spectrum, δ , m.d.: 0.74 (3H, t, J=7.5 Hz, CH₃), 1.50-1.84 (2H, m, CH₂), 3.04-3.34 [2H, m, S(CH₂)₂], 3.66-3.96 [2H, m, S(CH₂)₂], 4.38 (2H, t, J=6.5 Hz, OCH₂), 5.38-5.82 (1H, m, NCH), 6.94-7.72 (4H, arom. H).

2-Mercapto-1-(thiethanyl-3)benzimidazole (Vb). 0.76 gm (10 millimoles) of thiourea is added to a solution of 2.25 gm (10 millimoles) of compound IV in 100 ml ethanol, and boiled for 2 hours. The solution is cooled and filtered, and the filtrate is neutralized with sodium hydroxycarbonate. The precipitate is filtered out, dissolved in NaOH, and filtered, and then acetic acid diluted to pH 6-7 is added to the filtrate. The precipitate is filtered. This produces 0.9 gm (41 percent) of compound Vb. Melting point—139-141°C (ethanol). IR spectrum, ν_{max} , cm⁻¹: 2570 (SH).

Experimental Biology

Biochemical research was carried out on 142 male rats weighing 200-220 gm. The research material included the cerebral hemispheres, the myocardium, the liver and the small intestine. Lipids were extracted

from homogenates of these organs [8]. Lipid peroxidation products—diene conjugates—were determined spectrophotometrically by the method in [12], and the secondary products of lipid peroxidation—"cross-links" in aminophospholipids taking the form of Schiff bases—were determined spectrofluorometrically [11].

Diene conjugates were determined in cerebral hemispheres, the myocardium, the liver and the intestine of rats poisoned by Carbofos, Armin and tricresyl phosphate using a dose corresponding to the LD₅₀. Carbofos was administered per os at a dose of 260 mg/kg, Armin was administered intramuscularly at 1 mg/kg, and tricresyl phosphate was administered per os at 6,500 mg/kg.

The antiradical activity of benzimidazole derivatives, atropine and dipyrroxine antidotes, the known antioxidants Ionol and Bemtil [transliteration], and Dibazole were evaluated on the basis of the magnitude of constant K₇—the rate of the reaction between molecules of the compounds under analysis (inhibitors) and the peroxide radicals of ethylbenzene determined by chemiluminescence [10]. K₇ was calculated using the formula

$$K_7 = \left(\sqrt{\frac{I_0}{I}} - 1 \right) \frac{\sqrt{w_i K_6}}{[I_2 H]}$$

where I₀ and I—chemiluminescence intensity respectively before and after introduction of the inhibitor; w_i—rate of initiation of the reaction, m/sec; K₆—rate constant for recombination of the peroxide radicals of ethylbenzene at the given temperature; [I₂H]—concentration of the inhibitor.

Compound IIa (12.5 and 25 mg/kg) was investigated as a corrector of the membrane-toxic action of Carbofos in comparison with Ionol (120 mg/kg). These compounds were administered intraperitoneally together with atropine (5 mg/kg) and dipyrroxime (25 mg/kg) three times during the first day after poisoning. Tissues from the animals were analyzed on the 14th day after intoxication. The data were subjected to statistical treatment using an Elektronika MK-61 computer; the means, standard errors and Student's *t*-tests were computed. Differences between results in experiments and controls were assumed to be significant when *p*<0.05. The results of experiments run to investigate the acute toxicity of compound IIa were treated by the Litchfield-Wilcoxon method [3].

Table 1. Antiradical Activity of New Benzimidazole Derivatives

| Compound | K _r |
|---|----------------------|
| 2-(3,4-Dihydroxyphenacylthio)benzimidazole (IIa) | 1.51b10 ⁴ |
| 2-(3,4-Dihydroxyphenacylthio)-1-methylbenzimidazole (IIb) | 6.40b10 ³ |
| 3-(3,4-Dihydroxyphenyl)thiazolo[3,2-a]benzimidazole (III) | 4.80b10 ³ |
| 2-Propoxy-1-(thiethanyl-3)benzimidazole (Va) | 4.05b10 ² |
| 2-Mercapto-1-(thiethanyl-3)benzimidazole (Vb) | 2.80b10 ³ |
| Benzimidazole | 0 |
| Benzimidazolethione-2 | 9.93b10 ³ |
| Bemtil | 1.03b10 ³ |
| Dibasole | 5.89b10 ² |
| Atropine | 5.80b10 ¹ |
| Ionol | 2.30b10 ⁴ |

Table 2. Concentration of Diene Conjugates (D₂₃₂) in Organs of Rats Poisoned With OPC

| Experimental Conditions | Cerebral Hemisphere | Myocardium | Liver | Intestine |
|-------------------------|---------------------|----------------|---------------|---------------|
| Control | 0.18 +/- 0.01 | 0.37 +/- 0.01 | 0.40 +/- 0.01 | 0.42 +/- 0.06 |
| Carbofos | 0.47 +/- 0.04* | 1.10 +/- 0.10* | 0.51 +/- 0.05 | - |
| Armin | 0.24 +/- 0.04 | 0.42 +/- 0.03 | 0.42 +/- 0.02 | - |
| Tricresyl phosphate | 0.16 +/- 0.02 | 0.36 +/- 0.05 | 0.39 +/- 0.04 | 0.34 +/- 0.03 |

Note: Asterisk—differences are significant (p<0.05). D₂₃₂—extinction in the maximum of absorption of diene conjugates (232 nm).

Table 3. Effect of Compound IIa, Ionol and Antidotes on the Concentration of Diene Conjugates (D_{232}) in the Organs of Rats Poisoned by Carbofos

| Experimental Conditions | Cerebral Hemisphere | Myocardium |
|--|---------------------|------------------|
| 1. Control | 0.18 \pm 0.01 | 0.37 \pm 0.01 |
| 2. Carbofos | 0.59 \pm 0.03 | 1.41 \pm 0.10 |
| $P_{1,2}$ | <0.001 | <0.001 |
| 3. Carbofos + atropine + dipyrroxime | 0.40 \pm 0.06 | 0.80 \pm 0.04 |
| $P_{1,3}$ | <0.002 | <0.001 |
| $P_{2,3}$ | <0.02 | <0.001 |
| 4. Carbofos + atropine + dipyrroxime + Ionol | 0.22 \pm 0.04 | 0.51 \pm 0.003 |
| $P_{1,4}$ | >0.5 | <0.01 |
| $P_{2,4}$ | <0.001 | <0.001 |
| $P_{3,4}$ | <0.05 | <0.01 |
| 5. Carbofos + atropine + dipyrroxime + IIa | 0.17 \pm 0.03 | 0.33 \pm 0.01 |
| $P_{1,5}$ | >0.5 | >0.5 |
| $P_{2,5}$ | <0.001 | <0.001 |
| $P_{3,5}$ | <0.01 | <0.001 |
| $P_{4,5}$ | >0.5 | <0.001 |

The results of research on antiradical activity of the compounds, shown in Table 1, indicate that the activity of compound IIa is higher, and comparable to the action of Ionol. Compounds IIb, III, Vb, benzimidazolethione-2 and bemtil are an order of magnitude less active, while compound Va and Dibazole have insignificant activity. The value of constant K_7 is low for atropine, while dipyrroxime does not have antiradical activity ($K_7=0$), which may be an indication of the absence of antiradical action of the antidotes in a hydrophobic medium. Thus among the investigated benzimidazole derivatives, compound IIa has the highest antiradical activity. This is the compound we used in subsequent *in vivo* experiments.

Of the three investigated OPC, Carbofos has the highest pro-oxidant action; its target organs are the cerebral hemispheres and the myocardium (Table 2). This is also confirmed by a simultaneous increase in the quantity of secondary products of lipid peroxidation—Schiff bases—in the indicated organs. Poisoning of rats by Carbofos was the model used in the subsequent experiments.

It follows from Table 3 that when atropine and dipyrroxime are used therapeutically, they reduce the concen-

tration of diene conjugates in the cerebral hemispheres and myocardium of rats poisoned by Carbofos. At the same time a further decrease in concentration of diene conjugates in the myocardium and their normalization in the cerebral hemispheres are observed in rats treated with Ionol in addition to the antidotes. Compound IIa completely normalizes the concentration of diene conjugates in both target organs, with its effectiveness being significantly higher than that of Ionol in the myocardium. Compound IIa also holds an advantage over Ionol in breadth of pharmacological activity. The ratio LD_{50}/YeD_{50} is 16.6 for Ionol, and 28.8 for compound IIa.

Thus the research demonstrates good prospects for studying the antioxidant activity of compound IIa further, and seeking new antioxidants among benzimidazole derivatives.

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Synthesis and Properties of Immunotoxin CD5-Ricin

957A0623A Moscow BYULLETEN

EKSPERIMENTALNOY BIOLOGII I MEDITSINY

in Russian Jan 95 Vol 119 No 1, (manuscript received 17 Oct 94) pp 76-79

[Article by G. V. Vikha, L. D. Uzhinova, A. Zh. Kashayeva, V. V. Goshev, A. V. Krylov, A. Yu. Baryshnikov and R. G. Vasilov, AO Biotekhnologiya, Biotechnology Institute; Moscow State University imeni M. V. Lomonosov; Oncology Science Center, Russian Academy of Medical Sciences; the first paragraph is an introduction]

[FBIS Translated Text] The conditions for the conjugation of ricin with the original monoclonal antibodies IgG3 ICO-104 were investigated for the purpose of creating an end product with stipulated properties. The cytolytic activity of the synthesized immunotoxin, expressed in LD_{50} , determined by two independent methods, was $0.3-0.6 \times 10^{-7}$ M. The specificity of the immunotoxin relative to target cells containing the CD5 antigen is demonstrated.

Immunotoxins (IT) are hybrid proteins in which a selectivity of the cytolytic effect relative to target cells is ensured by attachment of the toxin (inhibitor of ribosomal synthesis) to specific monoclonal antibodies (MCA). These IT are used in eliminating an undesirable cell population with a well-expressed bioincompatibility reaction when cleaning bone marrow intended for autotransplantation.

The synthesis and properties of the IT, the conjugate of the inhibitor of ribosomal synthesis of plant ricin and MCA ICO-104 to the CD5-antigen of T cells, are outlined in this article. A description of the specificity of original MCA is given in [1]. The existence of variations between the MCA obtained from different hybridomas with respect to the isopoint of the quantity of oligosaccharide groupings, position and number of S-S links, is known. There also are other structural anomalies of MCA which are reflected in solubility, capacity for aggregating and breaking down into structural domains even under soft processing conditions. There are examples indicating that mouse immunoglobulins G (IgG) of different isotypes react differently to a pH change [5, 6]. A result of this may be a change in the microenvironment of the functional groups on the molecule surface. This may be manifested in the degree of their accessibility to the modifying agent, in connection with which the synthesis of IT was optimized and the factors mak-

ing it possible to obtain an end product with the greatest yield and with retention in the conjugate of the capacity to be bound with the cell antigen CD5 and to inhibit ribosomal synthesis in the target cell were studied.

Research Methods

Inoculated cell lines were used in the study: Jurkat — a line of T-cell non-Hodgkin's malignant lymphoma and K-562 — a line of tumorous erythroblastic cells [8], diethylaminoethyl-cellulose (DEAE 52, "Serva"), acrylex R-10 ("Reanal"), Sephadex G25F ("Pharmacia"), Sephacryl S-300 ("Pharmacia"), blue Sepharose CL 6B ("Pharmacia"), N-succinimidyl-3-(2-pyridyldithio)-propionate (SPDP, "Serva"), ricin

(PO Lektinotest, Lvov), 3-(4,5-dimethylthiazole-2-yl)-2,5-diphenyltetrazolium bromide (MTT, "Serva"), dithiotrytol ("Serva"); the remaining reagents with chemical purity or very high purity were produced in our country.

MCA IgG3 of the class ICO-104 were isolated by concentration on an Amicon PM-10 membrane of the cultural supernatant after separation of the hybridoma cells, separation of the low-molecular components of the medium in a column with P-10 acrylex in a 0.075 M sodium phosphate buffer pH 7.4 and subsequent negative sorption on diethylaminoethyl cellulose in the same buffer.

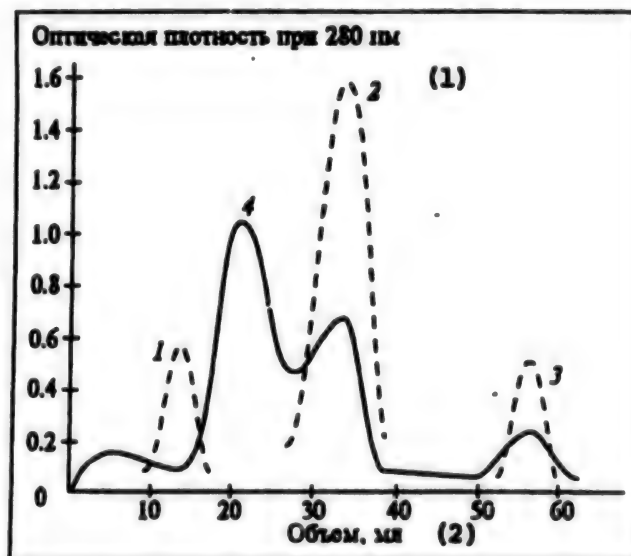


Fig 1. Chromatography of reaction products of thioldisulfide exchange on S-300 Sephadex in 0.1 M phosphate buffer pH 7.5. 1 — blue dextran, 2 — IgG, 3 — ricin, 4 — IT.

Key: 1. Optical density at 280 nm. 2. Volume, ml

Synthesis of ricin 2-pyridyldisulfide. In this procedure 150 μ g of SPDP, dissolved in 25 μ l of freshly distilled dimethylformamide, were added during mixing to 9-10 mg of ricin in a 0.05 M sodium borate buffer pH 7.5 and held at room temperature during continuous mixing, not allowing foam formation. After 30 minutes the reaction mixture was separated in a column (1.8 x 22 cm) with G25 F Sephadex, balanced by a 0.1 M phosphate buffer pH 7.5 with the addition of 0.1 M NaCl, 1 M of ethylenediaminetetraacetate (EDTA) and 0.02 percent sodium azide.

Synthesis of 2-pyridyldisulfide IgG3 ICO-104. In this procedure 92-185 μ g of SPDP, dissolved in 20-30 μ l of freshly distilled dimethylformamide, incubated at room temperature with vigorous mixing, were added to 8.6-21 mg of IgG3 ICO-104 in 2-2.5 ml of a 0.05 M sodium borate buffer pH 7.5. After 30 minutes the reaction mixture was separated in a column (1.8 x 30 cm) with G25 F Sephadex, balanced with a 0.1 M acetate buffer pH 4.5 with the addition of 0.1 M NaCl, 1 mM EDTA and 0.02 percent sodium azide.

Reduction of 2-pyridyldisulfide IgG3 ICO-104 by dithiotrytol. 2-pyridyldisulfide IgG3 ICO-104 in a volume 20-25 ml was concentrated on an Amicon PM-10 filter to a volume 2.6-6.8 ml, dithiotrytol was added to a concentration 17-42 mM and incubated at room temperature during mixing. After 30 minutes the reaction mixture was separated in a column (1.8 x 30 cm) with G25 F Sephadex, balanced with a 0.1 mM phosphate buffer pH 7.5, first saturated with nitrogen, with the addition of 0.1 M NaCl and 1 mM EDTA. The IgG3 ICO-140-thiol was collected in a volume 20-25 ml.

Conjugation. In this procedure 1.02-4.66 mg of ricin 2-pyridyldisulfide, incubated for 18 hours at room temperature, and then for 24 hours at 8°C, were immediately added to 2.6-11.6 mg of IgG3 ICO-104-thiol collected from the column. The reaction mixture was concentrated on an Amicon PM-10 membrane and separated in a column (1.0 x 90 cm) with S-300 Sephacryl in 0.01 M phosphate buffer pH 7.5 with the addition of 0.1 M NaCl and 1 mM EDTA (Fig. 1).

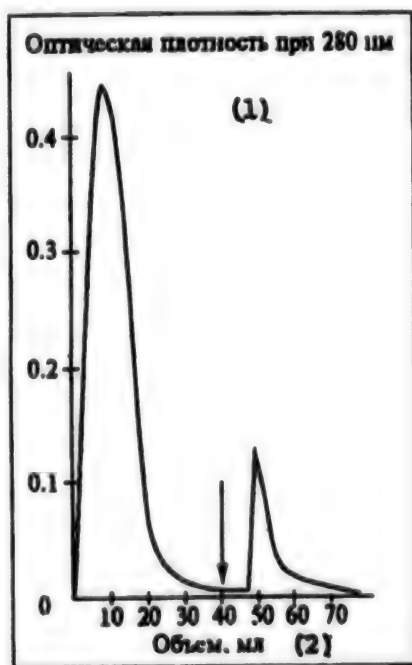


Fig. 2. Chromatography of fractions containing IT using CL 6B Sepharose. The arrow denotes the point of IT yield.

Key: 1. Optical density at 280 nm. 2. Volume, ml

The resulting conjugate was subjected to additional purification in a column (0.5 x 90 cm) with CL 6B blue Sepharose by the method described in [8]. The column was first processed with 1 mg IgG. Then 5.3 mg of conjugate in a volume 1 ml with 0.05 M of phosphate buffer pH 7.5 were introduced into the column. The purified conjugate was elutriated in 30 ml with a 26 percent yield (Fig. 2).

The number of substituted 2-pyridyldisulfide groups was determined by the method described in [3]. The modified ricin or IgG3 ICO-104 were processed with 25 mM by dithiotrytol with a pH 4.5 for 30 minutes at room temperature.

An analysis of the cytolytic activity of the conjugate IgG ICO-104 was made *in vitro* in cells of the Jurkat human lymphoblastoid line and the human erythroblastic line K-562.

A solid-phase immunochemical analysis of the cytolytic activity of the conjugate was made by the method described in [9]. The efficiency of the cytolytic effect of the conjugate was evaluated from the intensity of the stain with the addition of the vital dye MTT to Jurkat and K-562 cells after their incubation with the conjugate.

Then 12.5×10^3 cells in 50 μ l of the full medium (RPMI-1640, 4 mM L-glutamine, 4 μ g/ml of gentamicin, 10 percent fetal serum) were introduced into the holes of a 96-hole plate. The tested conjugate preparations in dilutions were introduced into the holes. Lactose was added to the corresponding holes.

Cells in the full medium, ricin and IgG3 ICO-104 in a full medium in dilutions were taken as a control.

Upon the elapsing of 20 hours of incubation at 37°C, 10 μ l of MTT (5 mg/ml in a 0.01 M phosphate buffer pH 7.4) were added to the holes and incubated for 4 hours at room temperature. Upon the elapsing of the incubation time the formazan forming in the course of the reaction was extracted by a 150 μ l mixture of 0.04 N HCl in isopropanol. The optical density was measured at 570 nm using a Multiscan ("Flow") photometer.

The cytolytic activity of the conjugates was determined by counting the live cells in a "Kvantitsit" — an instrument intended for the *in vivo* morphometry of cells fabricated by the experimental production unit of the Institute of Oncologic Problems im. Kavetskiy, Ukrainian Academy of Sciences.

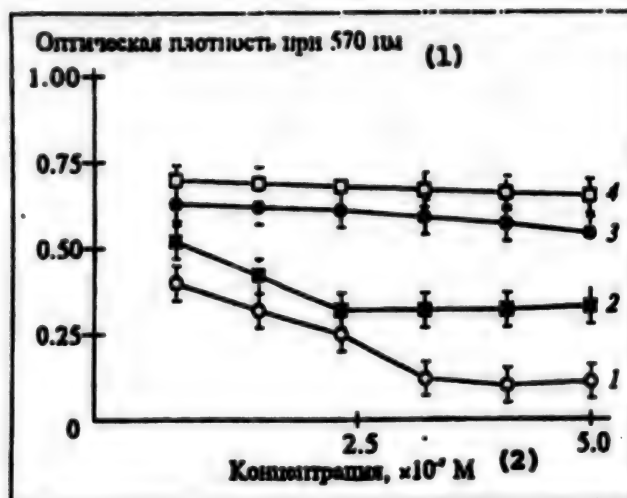


Fig. 3. Dependence of degree of inhibition of ribosomal synthesis in Jurkat (1,2) and K-562 cells (3-4) on IT concentration. 2, 4 — incubation of cells with IT was in the presence of 50 mm lactose.

Key: 1. Optical density at 570 nm. 2. Concentration, $\times 10^{-7}$ M

Cells in a full medium in a quantity $200-600 \times 10^3$ cells/ml and a solution of conjugate or ricin were introduced sterily into the instrument cell. In the control experiments the cells were incubated in a full medium. The incubation lasted 50 hours. The cell cycle was evaluated from the plateau phase.

Research Results

The synthesis of the conjugate IgG3 ICO-104-ricin was carried out by the method described in [4]. The 2-pyridyldisulfide groups in a molecule of modified ricin were linked to the thiol groups which were introduced into the IgG3 by pyridyldithiolation and subsequent reduction by dithiotrytol. Incubation of the proteins modified in such a way under soft conditions results in the formation of a conjugate in which these proteins are linked by a disulfide bridge. The structure of the conjugate is: $\text{IgG NH-OC-CH}_2\text{-CH}_2\text{-S-S-CH}_2\text{-CH}_2\text{-CO-NH-ricin}$.

The IgG3 ICO-104 and ricin were modified by the introduction of 2-pyridyldisulfide groups in SPDP excess. The reaction products were separated in a column with G25 F Sephadex. With a ricin concentration $1.5-1.6 \times 10^{-4}$ M and a ratio of ricin and SPDP 1:3 one 2-pyridyldisulfide group was introduced per one ricin molecule. The yield of modified ricin was 70-90 percent and a small aggregate peak appeared. With lower ricin concentrations in the reaction medium and with the same ricin:SPDP ratio the yield of modified ricin decreased to 55 percent, but the aggregate peak increased.

The reaction between IgG3 ICO-104 and SPDP took place with concentrations of the first $0.25-0.68 \times 10^{-4}$ M and IgG3:SPDP ratios 1:9.5, 1:5.2 and 1:4.3. In all cases 3 molecules of 2-pyridyldisulfide were introduced per one IgG3 ICO-104 molecule. A yield of 95 percent modified IgG3 ICO-104 was obtained with a concentration of the latter in the reaction mixture of 0.68×10^{-4} and a ratio IgG3:SPDP 1:4.3. Under these conditions the aggregation was minimal.

The 2-pyridyldisulfide of the IgG3 ICO-104 was reduced with a concentration of the latter $0.68-3.38 \times 10^{-4}$ M in the presence of 17-42 mM of dithiotrytol. The reduction of 2-pyridyldisulfide to thiol with a 94 percent yield of the end product transpires with a concentration of 2-pyridyldisulfide of IgG3 ICO-104 0.68×10^{-4} M in the presence of 17 mM dithiotrytol.

The reaction mixture contains not only the conjugate IgG3 ICO-104-ricin, but also polymer conjugates and incompletely reacted IgG3 and ricin. The aggregated polymer IgG3, as well as the incompletely reacted ricin, were easily separated in a column with S-300 Sephacryl (Fig. 1). There was no complete separation of the conjugate from the incompletely reacted IgG3 with S-300 Sephacryl and therefore a stage of chromatography of the fractions corresponding to the conjugates using CL 6B blue Sepharose was introduced. The separation of the conjugate and IgG3 was based on the property of the A-chain of ricin to bind with the dye F3GA-blue [7]. In chromatography with CL 6B blue Sepharose there is a separation from the incompletely reacted

IgG3, which is not bound with the dye F3GA-blue. The elutriation of the conjugates with CL 6B blue is attained with 0.5 M NaCl. The yield of purified conjugate was 26 percent relative to the introduced protein. An SDS-electrophoresis analysis of a 5-20 percent polyacrylamide gel gradient revealed the presence in the preparation after purification with CL 6B blue Sepharose of a single band corresponding in molecular weight to a hybrid molecule with a ratio IgG3-ricin 1:1 in the complete absence of the initial components participating in the thiol-disulfide exchange reaction.

The purified conjugate persisted after passage through a membrane of millipores 0.22 μm at -70°C for 2 months without an appreciable activity loss.

The cytolytic activity of the synthesized IT was determined by solid phase immunochemical analysis in 96-hole plates using the Jurkat human T-cell line (CD5-positive) and erythroblastic line of human K-562 cells (CD5-negative). A cell concentration (1.25×10^3 cells/ml) was selected for making the analysis and the degree of ribosomal synthesis was determined with different IT concentrations ($5-50 \times 10^{-7}$ M). K-562 cells, in which the CD5 antigen was not expressed, were taken as a comparison. At the same time experiments with inhibition of ribosomal synthesis were carried out in the presence of lactose, which, as indicated earlier, blocks the binding centers of the lectin part of the ricin — the B chain. The selective effect of the IT was evaluated from the IT LD_{50} difference for cells expressing the SD5-antigen (Jurkat) and cells not expressing this antigen on their surface. For Jurkat cells $\text{LD}_{50} = 0.6 \times 10^{-7}$ M; for K-562 cells 50 percent inhibition of ribosomal synthesis was not attained even with concentrations 10 times greater.

It must be noted that lactose safeguards both Jurkat cells and K-562 cells against the toxic effect of IT (Fig. 3). A similar result was noted in [2].

An analysis of the cytolytic activity of IT was made by direct counting of live cells in a "Kvantitsit" instrument, intended for the in vivo morphometry of cells when the Jurkat cells were incubated with different IT concentrations. A 50 percent survival of cells was observed with an IT concentration 0.3×10^{-7} M.

The principal parameter of an IT preparation is the concentration at which there is 50 percent inhibition of ribosomal synthesis in target cells. For the IT which we

synthesized on the basis of MCA ICO-104 close LD_{50} values were obtained by two independent methods.

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Characteristics of the Mechanism of Anticholinesterase Effect of Oxaphospholanol Derivatives

957A0549A Moscow

KHIMIKO-FARMATSEVTICHESKIY ZHURNAL

in Russian Vol 29, No 2, Feb 95 (received 29 Mar 94)
pp 12-13

[Article by R.S. Garayev, Kazan Medical Institute; UDC 616.909.15/644.72]

[FBIS Translated Text] Cholinesterase inhibition is the leading mechanism of effect of organophosphorus compounds used as pesticides [3, 5, 14]. However, their biological effects are varied and do not always have a connection with anticholinesterase properties [6].

The thought about the advisability of a directed synthesis of organophosphorus compounds with a low toxicity and a low anticholinesterase activity and a search among them for medicinal substances of a varied mechanism of action was expressed as long ago as the 1960's [1]. Organophosphorus medicinal preparations, which virtually do not have an anticholinesterase effect, have now been developed and introduced into medical practice [8, 10].

A study of the mechanisms of interaction of organophosphorus compounds with cholinesterase continues to interest specialists working in the field of development of both pesticides and drugs. An evaluation of anticholinesterase properties in 14 oxaphospholanol derivatives—(2-R-2-oxo(thioxo)-3,5,5-trimethyl-1,2-oxaphospholan-3-ol), which are 5-member phosphorus-containing heterocycles, was the object of this investigation. Their structure is presented below.



I:R=OMe; II, XIV:R=OEt; III:R=OPr; IV:R=OBu; V:R=OAm; VI:R=Me; VII:R=Et; VIII, IX:R=Ph; X:R=NMe₂; XI, XII:R=NEt₂; XIII:R=SEt; I-XIII:X=O; XIV:X=S I-VI, IX, X, XII-XIV — cis-isomers, VII, VIII, XI — trans-isomers [2]

The synthesis of compounds and the results of evaluation of their toxicity and neurotropic activity were published earlier [2, 7, 11].

Methods. The effect of compounds in final concentrations of 1 and 10 mmol/l on the activity of cholinesterase of mice brain and blood serum homogenates, as well as (of compound I-V) on the activity of purified enzyme preparations of acetylcholinesterase of erythrocytes and of butyrylcholinesterase of blood serum (produced by the Perm Scientific Research Institute of Vaccines and Serums), was studied in experiments in vitro by the S. Hestrin method [12]. The value I_{50} (concentration inhibiting cholinesterase activity 50 percent) of compound XIV was determined according to the results of the experiment conducted on the mice brain homogenate with an addition of the investigated preparation separately and jointly with the cholinesterase reactivator dipyroxim (8.7 mmol/l).

The hydrophoby of oxaphospholanol ethers (compounds I-V) was evaluated according to the Overton-Meyer coefficient determined on the basis of the ratio of their solubility in octanol to their solubility in water (K_{ow}).

Results and discussion. The investigated oxaphospholanol derivatives, with the exception of compound XIV, in the concentration of 1 mmol/l do not affect and in the concentration of 10 mmol/l weakly inhibit the activity of brain cholinesterase (Table 1). The degree of inhibition does not exceed 40 percent. The thiophosphoryl derivative (compound XIV) in the concentration of 1 mmol/l depresses enzyme activity 21.2 percent and in the concentration of 10 mmol/l, 100 percent. Its value I_{50} is equal to 5 mmol/l. Dipyroxim does not have a reactivating effect on cholinesterase inhibited 50 percent by compound XIV, although it fully restores the anticholinesterase effect of phosphacol. Possibly, the weak anticholinesterase effect of oxaphospholanol derivatives, in contrast to the effect of phosphacol, is not connected with the phosphorylation of the esterase center of cholinesterase.

Table 1. Effect of Oxaphospholanol Derivatives on the Activity of Cholinesterase of Mice Brain and Blood Serum Homogenate in Experiments in Vitro

| Compound | Inhibition of Cholinesterase Activity, % | | | |
|----------|--|-------------|-------------|----------------|
| | brain | | blood serum | |
| | 10^{-3} M | 10^{-2} M | 10^{-3} M | 10^{-2} M |
| I | 0 | 34.9 | 13.3 | 27.1 \pm 2.1 |
| II | 0 | 37.2 | 15.5 | 44.3 \pm 1.0 |
| III | 0 | 26.7 | 24.6 | 55.2 \pm 2.8 |
| IV | 0 | 33.4 | 27.7 | 71.4 \pm 2.3 |
| V | 0 | 28.9 | 30.7 | 79.3 \pm 1.3 |
| VI | 0 | 0 | - | - |
| VII | 0 | 0 | - | - |
| VIII | 0 | 0 | - | - |
| IX | 0 | 7.6 | 29.3 | 74.6 |
| X | 0 | 0 | 7.3 | 14.8 |
| XI | 0 | 0 | 7.3 | 33.2 |
| XII | 0 | 3.3 | 24.6 | 70.0 \pm 3.4 |
| XIII | 0 | 40.1 | 15.5 | 62.5 |
| XIV | 21.2 | 100.0 | - | 100.0 |

In experiments on blood serum the anticholinesterase effect of the investigated substances in the concentration of 10 mmol/l rises depending on the increase in

their molecular mass (see Table 1). Similar properties were also detected in experiments on purified enzyme preparations of butyryl cholinesterase (Table 2).

Table 2. Effect of Oxaphospholanol Ethers in Concentration of 10^{-3} M on Activity of Acetylcholinesterase of Erythrocytes and of Butyrylcholinesterase of Blood Serum

| Compound | Inhibition of Enzyme Activity, % | |
|----------|----------------------------------|-----------------------|
| | Acetylcholinesterase | Butyrylcholinesterase |
| I | 28.8 \pm 1.5 | 30.5 \pm 2.8 |
| II | 32.4 \pm 2.4 | 52.3 \pm 1.6 |
| III | 27.8 \pm 1.4 | 62.4 \pm 1.5 |
| IV | 24.1 \pm 1.4 | 87.0 \pm 2.6 |
| V | 26.9 \pm 1.3 | 93.1 \pm 4.0 |

Oxaphospholanol ethers in the concentration of 10 mmol/l weakly depress the activity of the purified acetylcholinesterase enzyme (24 to 32.5 percent) and a pattern depending on the chemical structure has not been detected in their action (see Table 2).

As the molecular mass in the series of oxaphospholanol ethers increases (which depends on the number of methylene groups in the ether radical), hydrophoby (K_{ow}) rises (Table 3) and the percent of inhibition of cholinesterase activity under the effect of these sub-

stances has a strong correlation ($r=0.965$) with their hydrophoby. These results indicate that cholinesterase inhibition by oxaphospholanol derivatives, possibly, occurs through hydrophobic interaction with the enzyme. In classic research [4, 13] the interaction of organophosphorus compounds with hydrophobic cholinesterase sections was considered a factor ensuring the inhibitor's orientation on the active enzyme surface, which predetermines the reaction of phosphorylation with the esterase center.

Table 3. Solubility of Oxaphospholanol Ethers in Octanol and Water and Coefficient of Octanol/Water Solubility (K_{ow})

| Compound | Solubility | | K_{ow} | $\lg(10 \times K_{ow})$ |
|----------|------------|----------|----------|-------------------------|
| | in octanol | in water | | |
| I | 1:32 | 1:6 | 0.19 | 0.2788 |
| II | 1:10 | 1:10 | 1.0 | 1.0 |
| III | 1:9 | 1:20 | 2.2 | 1.3424 |
| IV | 1:2 | 1:40 | 20.0 | 2.3010 |
| V | 1:2.5 | 1:120 | 48.0 | 2.6812 |

The lack of an anticholinesterase effect in oxaphospholanol ethers is also confirmed by experiments with the use of microelectrode equipment on the nerve-muscle preparation of the frog under conditions of preservation of the functional activity of the test-object.

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Contribution of Dopamine Autoreceptors to the Reactivating Effect of Opioid Antagonists

957A0811A Moscow BYULLETEN

EKSPERIMENTALNOY BIOLOGII I MEDITSINY

in Russian Feb 95 Vol 119 No 2, pp 120-124

[Article by N.I. Dubrovina, Memory Regulation Mechanisms Laboratory (director, Professor R.Yu. Ilyuchenok), Physiology Institute, Siberian Department, Russian Academy of Medical Sciences, Novosibirsk; manuscript received 20 Feb 94]

[FBIS Abstract] The contribution of dopamine autoreceptors to the reactivating effect of opioid antagonists under conditions of amnesia and spontaneous forgetting was examined in a series of experiments performed on male BALB/c mice weighing 17 to 23 g each. Standard methods were used to condition a passive avoidance response in the mice by placing them into an experimental chamber with two compartments: a light (safe) compartment and a (dark) dangerous compartment. On the day of the training session, the mice were transferred to the dark compartment where they received a 1-mA electric shock for 2 seconds. The amnesia effect consisted of leaving the animals in the dangerous compartment for 5 minutes directly after administration of the electric shock. The spontaneous forgetting entailed having a 21-day break between the first test (conducted 1 day after the training session) and the subsequent test. After the first test, the latent transfer period of which amounted to 180 seconds, the animals were returned to their cages and allowed to spontaneously forget the incident. In the subsequent experiment, mice with a latent transition period after the 21-day break of less than 45 seconds were used. Before the training (in the series involving spontaneous forgetting) or before the training and amnesia (the series with psychogenic amnesia), the animals' dopamine autoreceptors were preliminarily activated by the selective agonist (+)3PPP (Astra Lakemedel) in a dose of 2 mg/kg. Before the testing on day 2 (the series involving the amnesia) or day 22 (the series involving spontaneous forgetting), the mice were injected with the antagonist naloxone (which primarily antagonizes the μ -opiate receptors) in a dose of 2 mg/kg or the selective δ -receptor agonist ICI174,864 (Imperial Chemical Industries) in a dose of 3 mg/kg. The control mice received a physiologic solution. All of the preparations were injected into the mice intraperitoneally in a volume of 0.2 ml per mouse. The mice were divided into 12 groups of 11 to 15 mice each, including a control group and groups of mice receiving one or more of the aforesaid preparations at different times during the experiments and either allowed to forget their training or inflicted with amnesia. Preliminary activation of the animals' dopamine autoreceptors had no effect on training or on the development of amnesia or forgetting. Nor did spontaneous restoration of the conditioned reflex of passive avoidance occur during amnesia or forgetting. Preliminary activation of the dopamine autoreceptors did,

however, alter the nature of the reactivating effects of the μ - and δ -receptor antagonists. In the mice with amnesia induced against a background of physiologic solution, the drugs ICI174,864 (3 mg/kg) and naloxone (2 mg/kg) facilitated an increase in latent transition period, thus indicating restoration of the conditioned reflex of passive avoidance. Preliminary injection of (+)3PPP, on the other hand, blocked the opioid antagonists' reactivating effect. In the case of the mice given time to forget their training, activation of the dopamine autoreceptors only blocked the efficacy of ICI174,864 (2 mg/kg) injected on day 22 after training. It was concluded that the dopamine system must be functioning normally in order for restoration of a conditioned reflex of passive avoidance to occur in cases of amnesia induced by blocking the μ - and β -receptors. It was further concluded that in the case of recovery of a forgotten memory, dopamine-opioid interactions are likely dictated by the functional heterogeneity of the μ - and δ -receptors and by a decrease in the dopamine system's role in the said process. Figures 2, tables 2; references 12: 4 Russian, 8 Western.

Neurotropic Effects of Lyuliberin Analogue Upon Intragastric Injection Into Mice With Varying Degrees of Sensitivity to Ethanol

957A0811B Moscow BYULLETEN

EKSPERIMENTALNOY BIOLOGII I MEDITSINY

in Russian Feb 95 Vol 119 No 2, pp 129-132

[Article by L.A. Severyanova, professor, and I.I. Bobyntsev, Pathologic Physiology Department, Kursk State Medical Institute (head, L.A. Severyanova); manuscript received 14 Mar 93]

[FBIS Abstract] A previous study established that systemic (intraperitoneal) injection of the lyuliberin analogue surfagon into rats with varying degrees of sensitivity to ethanol produces direct neurotropic effects. Additional experiments were performed on 132 non-pedigree male rats weighing 180 to 210 g each for the purpose of clarifying the mechanisms of surfagon's previously established effect. The rats were divided into groups of 10-12 rats each based on their sensitivity to ethanol and were classified as either short-sleeping or long-sleeping. In the first of two series of experiments performed, the effects of surfagon were studied in 64 intact rats. In the second series of experiments, surfagon's effects in castrated rats were studied. The surfagon was synthesized at the Experimental Cardiology Institute of the Cardiac Research Center of the Russia Academy of Medical Sciences. Five days before the behavior tests, cannulas were implanted into the right ventricles of the rats' brains. The peptide was administered slowly in doses of 3 and 30 ng in 3 μ l of a physiologic solution 10 minutes before the behavior tests were begun. The castration operations were performed 12 days before the start of the experiments. A battery of tests was used to determine the rats' pain stress, aggressive-defensive

behavior, the vertical component of their orientation activity, their emotional state, their frequency of grooming, and their frequency of urination. All results were analyzed by Student's *t*-test. Under controlled conditions, the short-sleeping rats were observed to perform the following actions when exposed to different amounts of electric voltage: shudder at 20.6 \pm 0.7 V, squeak at 27.2 \pm 0.6 V, rise at 31.33 \pm 0.7 V, run at 38.9 \pm 0.5 V, and fight at 47.7 \pm 1.3 V. In addition, convulsions developed in 100 percent of the rats. In contrast, the long-sleeping rats performed the respective actions at the following levels of electric voltage: shudder, 20.6 \pm 0.5 V; squeak, 31.28 \pm 1.0; rise, 33.7 \pm 0.7; run, 53.1 \pm 0.56; and fight, 61.8 \pm 0.7. Convulsions developed in 90 percent of the long-sleeping rats. When compared with the long-sleeping rats, the short-sleeping rats were more excitable and more aggressive. In the short-sleeping rats, administration of surfagon in a dose of 3 ng induced an 11-17 percent increase in the thresholds of all components of aggressive-defensive behavior against the background of a rather high level of affective aggression and intensification of vertical activity (by 52 percent). As the dose of surfagon was increased to 30 ng, a sharp decrease in the frequency of fights and an increase in the frequency of convulsions (to 84 percent) were noted in response to the electric current applied. In the long-sleeping rats, surfagon did not induce any statistically significant changes in thresholds of the pain and defensive components of behavior. The peptide did, however, increase grooming in the long-sleeping rats by a factor of 6.4-7.6 and did suppress their vertical activity by 25-26 percent. In the short-sleeping rats, similar changes were observed after administration of surfagon in a dose of 30 ng. The observed behavioral effects were found to not be mediated by sex hormones. It was concluded that surfagon's effects on the central gray matter of the midbrain and limbic structures are largely responsible for the behavioral changes it induces in the short-sleeping and long-sleeping rats. Figures 2; references 13: 3 Russian, 10 Western.

Effect of Perfluorodecalin on the Toxicity of Picrotoxin and Selected Detoxification Systems

957A0811C Moscow BYULLETEN
EKSPERIMENTALNOY BIOLOGII I MEDITSINY
in Russian Feb 95 Vol 119 No 2, pp 176-178

[Article by A.I. Golovko, N.N. Pluzhnikov, and G.A. Sofronov, Military Medical Academy, St. Petersburg; manuscript received 11 Mar 94]

[FBIS Abstract] The effect of perfluorodecalin on the toxicity of picrotoxin and selected detoxication systems was studied in experiments performed on white mice and rats weighing 20-22 and 170-200 g, respectively. A

phospholipid emulsion of perfluorodecalin was injected into the animals intraperitoneally [IP] in a dose of 1,930 mg/kg in a volume of 0.1 ml per 10 g of body weight in the case of the mice and 1 ml per g of body weight in the case of the rats. The picrotoxin (Serva) used in the experiments involving the mice was suspended with Twin-80 in a physiologic solution. In the experiments involving the rats, the picrotoxin was dissolved in a 25 percent solution of dimethylsulfoxide. Toxicity was determined by the animals' 2-hour survival after IP injections of the picrotoxin in tests using at least five doses of the toxin and at least six animals per dose. Ten minutes before the animals were injected with the picrotoxin, they were injected with diazepam in a dose of 5 mg/kg. A regression analysis by the least squares method was used to calculate the median lethal dose. Activity of the detoxication system was determined 7 days after the rats had been injected with perfluorodecalin. Evaluation of the condition of their monooxygenase system was based on the length of hexenal-induced sleep and the level of cytochrome P-450 in the liver. Methods described elsewhere were used to determine the activity of various enzymes in the animals. Preliminary injection of perfluorodecalin increased the rodents' resistance to picrotoxin's toxic effects. Perfluorodecalin had a statistically significant prophylactic effect in the mice for 14 days after injection. Its protection coefficient (i.e., the ratio of the median lethal dose [LD₅₀] of the experimental group to that of the control group) after 1 and 3 weeks equaled 1.6 and 1.45, respectively. In the rats, perfluorodecalin increased resistance to picrotoxin by a factor of 1.8 on day 7 after injection of the fluoroarcon. Preliminary (7 days before the picrotoxin was injected) injection of the perfluorodecalin intensified the antidotal activity of diazepam in the mice poisoned with picrotoxin. In the experimental group of mice that had received the perfluorodecalin 7 days before being injected with picrotoxin, the duration of hexenal-induced sleep increased by a factor of 7.5 as compared with the duration measured for the mice in the control group. Perfluorodecalin induced increases in a number of indicators reflecting the functional state of the various detoxication mechanisms. Its effect was greatest with respect to monooxygenase, carboxylesterase, glutathione-S-transferase, uridinediphosphate-glucuronosyltransferase, glutathione-reductase activity, and the level of water-soluble inhibitors of free radicals. The protective effect of perfluorodecalin was thus linked to induction of the body's detoxication systems, above all, to an increase in carboxylesterase activity and protein levels in the blood serum. Tables 3; references 16: 11 Russian, 5 Western.

Selected Features of the Effect of "Murine" Toxin and Antigen of Fraction I of *Yersinia pestis* on Plague-Sensitive Cells in Animals

957A0811D Moscow BYULLETEN
EKSPERIMENTALNOY BIOLOGII I MEDITSINY
in Russian Feb 95 Vol 119 No 2, pp 193-195

[Article by L.Ye. Aseyeva, M.B. Mishankin, Ye.K. Goncharov, and L.A. Shevchenko, Microbe Biochemistry Laboratory (head, Professor B.N. Mishankin), Antiplague Scientific Research Institute, Rostov-na-Donu; manuscript received 14 Feb 94]

[FBIS Abstract] The effects of antigen fraction I [AFI] and murine toxin on the peritoneal leukocytes and macrophages of white mice and guinea pigs were compared in *in vitro* experiments. The AFI was isolated from plague microbe and the murine toxin was obtained from the OH5 α strain of colon bacillus carrying recombinant plasmid with a cloned murine toxin gene. The preparations of murine toxin from plague microbe and colon bacillus were identical from the standpoint of their physicochemical and serologic properties. According to electrophoretic mobility data, the toxin had a molecular weight of 61 kD and median lethal dose [LD₅₀] for white mice of 0.6-1.2 μ g. Luminol-dependent chemiluminescence under the effect of AFI and murine toxin was determined on peritoneal leukocytes and macrophages of nonpedigree white mice and guinea pigs as described elsewhere. The toxin's phosphorylating and dephosphorylating activity was determined on membrane and cytosol fractions of the animals' peritoneal leukocytes. Protein kinase activity was registered by using adenosine triphosphate as described elsewhere, and tyrosinephosphatase activity was determined by using O-phospho-L-tyrosine as a substrate. Electrophoresis of the membrane and cytosol fractions was performed in 10 percent polyacrylamide gel with 0.1 percent sodium dodecylsulfate. Autoradiograms were taken after the dried gel plates had been in contact with RM-V x-ray film for 5 days. The luminol-dependent chemiluminescence of the peritoneal leukocytes and macrophages of the white mice in response to treatment with AFI in concentrations from 0.01 to 100 μ g per sample differed from that of the guinea pigs. Adding 10 to 10 μ g of capsular antigen to a sample of white mouse leukocytes resulted in a 125-150 percent increase in the intensity of chemiluminescence. The response developed quickly, peaking 1-2 minutes after the antigen had been added. Decreasing the concentration to 0.01-1.0 μ g resulted in a slight increase in chemiluminescence to 105-110 percent followed by a decrease to 50-85 percent. Subsequent addition of live *E. coli* cells (10⁷ cells of the strain QD 5003) to estimate the potential functional state of the leukocytes resulted in an additional sharp increase in

intensity of chemiluminescence. In the guinea pigs, on the other hand, the response of the guinea pigs' peritoneal leukocytes under the effect of AFI decreased to 30-45 percent. The same effect was also observed after AFI had been added in a quantity of 0.01-1.0 μ g. The murine toxin obtained from plague microbe had the exact opposite effect on the leukocytes: Within the range of concentrations studied, the murine toxin intensified the metabolic explosion of peritoneal leukocytes in the guinea pigs but suppressed their functional activity in the white mice. No statistically significant differences in the intensity of macrophage chemiluminescence in the white mice and guinea pigs in response to treatment with AFI and murine toxin was detected. The said findings were said to be consistent with a 1985 study indicating a close link between chemiluminescence and the formation of active forms of oxygen in leukocytes. The murine toxin (16 μ g in a sample) was found to be capable of stimulating the phosphorylation of a number of proteins with a molecular weight of 45-90 kD in the membrane and cytosol fractions of guinea pig peritoneal leukocytes. Murine toxin from plague microbe inhibited phosphorylation in the membrane fractions of the white mouse leukocytes by 65 percent. The said inhibition was correlated with a 50 percent increase in tyrosinephosphatase activity. Figures 2; references 10: 2 Russian, 8 Western.

Psychotropic Effects of Thymogen

957A0811E Moscow BYULLETEN
EKSPERIMENTALNOY BIOLOGII I MEDITSINY
in Russian Feb 95 Vol 119 No 2, pp 199-200

[Article by T.I. Nevidimova and N.I. Suslov, Immunobiology Laboratory, Mental Health Scientific Research Institute, and Neuropsychopharmacology Laboratory, Pharmacology Scientific Research Institute, Tomsk Scientific Center, Siberian Department, Russian Academy of Medical Sciences; manuscript received 15 Mar 94]

[FBIS Abstract] The effects of thymogen on the behavioral and immunologic characteristics of experimental animals under conditions of stress were studied in experiments performed on nonpedigree white mice and mice of the line CBA weighing 18-22 g each. The mice were divided into groups of 12 animals each. A total of 240 animals were studied. The experimental group received thymogen (Tsitomed) in two doses (100 and 15 μ g/kg) in single intraperitoneal injections for 5 days, whereas the control group received a physiologic solution in the same injection schedule. An "open field" test was set up to study the animal's orientation and exploratory behavior. The effects of thymogen on the animals' emotional state, behavior in a labyrinth, reaction to stress induced by 22 hours of immobilization, and

behavior in a conflict situation (i.e., electric shock punishment for executing a conditioned drinking response) were evaluated and their levels of leukocytes and blood antibodies measured. The behavior tests established that thymogen does appear to have an antidepressive and psychostimulating effect. The level of stress in animals injected with thymogen before being immobilized was rated between 2 and 4 points, while the stress level of the immobilized controls was given a rating of 6 points. Thymogen's stress-protective effect was especially apparent in the thymus. Thymogen did not have a clear-cut effect on the animals' orientation and exploratory activity in the open field test; however, it did reduce stress-induced behavior changes and stimulated motor activity under conditions of a conflict situation. Forty-eight hours after the mice were subjected to a conflict situation, leukocytosis (primarily due to lymphocytosis) developed in the controls, whereas the immunologic parameters of the animals given thymogen in a dose of 100 µg/kg were similar to those of the intact controls. The mice in the experimental group manifested a decrease in the number of cells in their thymus (evidently as a result of redistribution of immunocompetent cells) and a decrease in their index of thymocyte cytotoxicity (their level of natural killing was similar to that in the immunologic controls). A trend toward interconnection of behavioral and immunologic parameters was observed in the experimental group. Two groups of animals were identified: The first was characterized by more frequent approaches to the water trough, a lower number of leukocytes, and an increased number of thymocytes, while the second group was characterized by the opposite characteristics. Thymogen was thus demonstrated to have a positive effect on integrative processes in the brain and a possible antidepressive and psychostimulating effect. Under conditions of acute stress and conflict, thymogen improved behavioral, somatic, and hematoimmunologic indicators. Tables 2; references 11: 9 Russian, 2 Western.

Immunological Biomonitoring in Neighborhood of Major Gasworks

957A0801A Moscow IMMUNOLOGIYA in Russian
Feb 95 No 2, (manuscript received 11 Oct 93) pp 56-58

[Article by V. A. Bochanovskiy, A. A. Rezayev, V. I. Balashov, I. S. Kaminskaya, N. G. Urlyapova, G. A. Belokrylov, L. S. Kositskaya, O. Ya. Popova, R. P. Ogurtsov, Ye. P. Kiseleva, P. G. Nazarov, A. V. Polevshchikov and I. S. Freydlin, Ekologicheskaya meditsina Scientific Research Center, Astrakhangazprom Concern, Astrakhan; Experimental Medicine Scientific Research Institute, Russian Academy of Medical

Sciences, St. Petersburg; UDC 616-092:612.017.1]-02:614.71/.73]-07]

[FBIS Abstract] Mice of the CBA line were exposed for 4 months in an atmosphere polluted by the gaseous products of the production and processing of natural gas (SO₂, H₂, nitric oxide, carbon and others) in the immediate neighborhood of the Astrakhan Gasworks. Taking into account the quantitative differences at the cell and organ levels in the immune system of experimental and control groups of CBA mice and the absence of clear intergroup differences in the functioning of immunocompetent cells, it was concluded that there were quite effective compensatory mechanisms in mice exposed in the zone of exposure to aggressive gas components. This also was confirmed by the absence of reliable differences in the number of antibody forming cells in the spleen formed on the fourth day in the course of primary response. After 4 months of exposure in the immediate neighborhood of the gasworks there probably were no irreversible changes in the form of autoimmune diseases. The greatest differences were in the mass of the thymus, the content of Thy-1⁺ cells in the spleen and spleen mass, probably a consequence of impairment of processes of differentiation and migration of T cells and their precursors, confirmed by an increase in the number of antibody forming cells in the bone marrow by a factor 2.05. There is therefore evidence of impairments in the processes of maturing of T cells, a dropoff in their number in the blood and lymphoid organs and activation of feedback mechanisms which ensure an increase in the number of colony forming units in the bone marrow. The principal target of anomalous ecologic factors is therefore the processes transpiring in the thymus. There was a change in the migration and differentiation of T cells but a great stability of B cells and mononuclear phagocytes. The reduction in the number of T cells was not accompanied by a decrease in the functional activity of the immunocompetent cells. References 11: 9 Russian, 2 Western.

Immunomodulating Properties of New Pyrimidine Derivatives

957A0801B Moscow IMMUNOLOGIYA in Russian
Feb 95 No 2, (manuscript received 15 Mar 94) pp 59-61

[Article by D. N. Lazareva, S. S. Volkova, F. S. Zarudiy, V. A. Davydova, A. F. Ismagilova, G. A. Tolstikov, V. P. Krivonogov and F. Kh. Kamilov, Ufa Organic Chemistry Institute, Russian Academy of Sciences; Bashkinskiy Medical Institute; UDC 615.276.2.015.46.038]

[FBIS Abstract] White mice were used in studying the toxicity and immunotropic activity of nine new pyrimidine derivatives (listed in a table) in a search for

new immunomodulators. Acute toxicity of these compounds was observed when these were administered intraperitoneally. The influence of these compounds on the humoral link of immune response was judged from the number of antibody-forming cells, determined on the fourth day after immunization of the mice by intraperitoneal administration of sheep erythrocytes. The compounds were injected four days after immunization in doses 1/10 and 1/30 LD₅₀ for 2-methyl-4-amino-6-oxypyrimidine (24-93), for example, and in doses 1/100 and 1/500 LD₅₀ for oxymethyluracil; similar studies were made for 1,3-bis(isobutylthioethyl)-5-isobutylthio-ethoxy-6-methyluracil (11-8-93) and other pyrimidines. The compound 24-93, for example, was more effective than oxymethyluracil when administered in doses 25 mg/kg. The importance of the oxygroup or other radicals for the carbon atom in the fifth or sixth position for uracil derivatives as immunostimulators, as postulated earlier by the authors, was therefore confirmed. The most active immunomodulators among the studied derivatives were the compounds 24-93 and 11-89-3. The earlier collected data on stimulation of the absorptivity of macrophages and increase in resistance to infection by the compound 24-93 are evidence of its high effectiveness as an immunostimulator. The compound 24-93 increases the effectiveness of antibiotic therapy for experimental infections, reducing the number of dead animals and increasing their life span. Its simplicity of synthesis and great therapeutic breadth are indicative of considerable promise of the compound 24-93 as an immunostimulator. Figure 1; references 8: 6 Russian, 2 Western.

Fundamental and Applied Problems in Current Research on Regulator Peptides

957A0842A Moscow VESTNIK ROSSIYSKOY
AKADEMII MEDITSINSKIKH NAUK in Russian
Feb 95 No 2, (manuscript received 1 Mar 94) pp 10-12

[Article by O. A. Gomazkov, Institute of Biomedical Chemistry, Russian Academy of Medical Sciences, Moscow; UDC 612.015.3:577.112.6]:001.5]

[FBIS Abstract] The wide variety of regulator peptides is outlined. Some principles of the classification and function of regulator peptides are summarized. The generation of peptides is treated as a complex, multi-step process. The multi-faceted yet specific functions of regulator peptides are considered: while the peptide may do many things, it does one specific thing in a certain situation. Actual clinical use of regulator peptides

is extremely limited compared to the vast amount of information that has been gathered about their activity. One method of use is long-term immunization with peptides to alter individual physiological functions. Clinical use of angiotensin-converting enzyme inhibitors is described. These substances have been studied using a two-prong approach because of their dual action as an angiotensin II former and a bradykinin degrader. Regional sovereignty of some systems of regulator peptides is discussed. Current directions of research include the search for tissue-specific inhibitors. References 12: 5 Russian, 7 Western.

Pursuit, Isolation, and Study of Restrictases

957A0842B Moscow VESTNIK ROSSIYSKOY
AKADEMII MEDITSINSKIKH NAUK in Russian
Feb 95 No 2, (manuscript received 3 Feb 94) pp 47-51

[Article by N. N. Sokolov, Institute of Biomedical Chemistry; UDC 612.015.1:577.152.277].08]

[FBIS Abstract] The three classes of restrictases are described. Classes I and II are multi-function proteins that can cleave or methylate DNA. Class II restrictases are oligomeric proteins which cleave unmodified DNA at strictly defined nucleotide sequences (4-7 nucleotides). More than 2000 restrictases have been found in class II. Scientists are searching for restrictases with new specificities, more productive strains to synthesize restrictase-isoschizomers, and more effective purification methods. Laboratories are focusing on new screening methods, specificity analysis, and small-scale serial production of some restrictases. There is also an ongoing search for restrictases which cleave larger nucleotide sequences (more than eight nucleotides). A table compares characteristics of methods used to test the activity of restrictases. A method developed at the authors' laboratory is described which is based on periplasmatic localization of restrictases in a microbe cell. Membrane permeability is increased with toluene. Screening results are presented in a table. A new purification method is described which is based on selective fractioning of interfering nonspecific endonucleases in a cell-less extract using isopropanol. A total of 32 newly isolated and identified site-specific endonucleases are listed. The study of PaeI and PaeBI is described. The effect of low concentrations of zinc in restrictase activation (and suppression of activity at higher zinc concentrations) is noted. Figure 1; tables 4; references 41: 20 Russian, 21 Western.

Versatile Reagent for Synthesizing Modified Oligonucleotides

957A0848A Moscow BIOORGANICHESKAYA
KHIMIYA in Russian Feb 95 Vol 21 No 2, pp 124-129

[Article by M.S. Shchepinov, V.G. Korobko, and V.N. Dobrynin (deceased), Bioorganic Chemistry Institute imeni M.M. Shemyakin and Yu.A. Ovchinnikov, Russian Academy of Sciences, Moscow; manuscript received 13 Jul 94; UDC 577.113.6]

[FBIS Abstract] A phosphoramidite derivative of 2-dimethoxytrityloxy-2'-hydroxyethyl disulfide was synthesized and shown to be a convenient reagent for synthesizing various oligonucleotide derivatives by the phosphoramidite approach. The new reagent, O'-dimethoxytrityl-O⁶-(N,N-diisopropylamino-2-cyanoethoxyphosphinyl)-3,4-dithia-1,6-hexanediol, was synthesized as follows: 1 g (2.2 mol) of the alcohol 2-dimethoxytrityloxy-2'-hydroxyethyl disulfide was dried for 24 hours in a vacuum over P₂O₅ and then transferred in argon into 15 ml of dry methylene chloride. Next, 0.38 g (2.2 mmol) of dry diisopropylammonium tetrazolide and 0.66 ml (2.2 mmol) of bis-N,N-diisopropylamino-2-cyanoethylphosphite were added, and the mixture was stirred in the presence of a catalytic quantity of diacetylcyclodithiothreitol in argon for 1.5 hours at 0°C. The reaction mixture was then rinsed with 50 ml of a saturated NaHCO₃ solution, dried (with Na₂SO₄), evaporated, dissolved in 50 ml of acetonitrile, cooled to 5°C, and quickly rinsed (2 x 15 ml) with cold hexane. The acetonitrile fraction was evaporated, quickly purified at 5°C in a column containing silica gel, and then dried for one day in a vacuum (0.04 torr). The synthesis process resulted in 0.8 g (a 55 percent yield) of a colorless oil that was stored at -20°C. The structure of the phosphoramidite reagent and oligonucleotide containing an alkylthiophosphate bond was confirmed by nuclear magnetic resonance spectroscopy. Its mass spectra were as follows: 1) m/z⁺, 303, 456 (M); 2) ¹H NMR (CDCl₃, δ, ppm) 7.6-6.7 (m, 13H, aromatic), 4.12 (m, 2H, CH₂OP), 3.78 (c, 6H, OCH₃), 3.38 (m, 2H, PNCH), 3.01 (t, 2H, J 6 Hz, DMTrOCH₂), 2.85-2.67 (m, 6H, CH₂SSCH₂, POCH₂CH₂CN), 2.52 (s, 2H, CH₂CN), 1.4-1.2 (m, 12H, CHCH₃); and 3) ³¹P-NMR (CDCl₃), 146.053. The new reagent was used to synthesize 3'- and 5'-phosphates, 3'-thiooligonucleotides, 5'-thiooligonucleotides, and alkylthiophosphate and disulfide oligonucleotide derivatives. The resistance of the alkylthiophosphate and disulfide bonds in the oligonucleotides to the effects of silver nitrate and dithiothreitol was estimated. The structure of the phosphoramidite reagent and oligonucleotide containing

an alkylthiophosphate bond was confirmed by nuclear magnetic resonance spectroscopy. Figures 4; references 41: 5 Russian, 36 Western.

Fragments 183-198 and 125-145 of the α-Subunit of Nicotinic Acetylcholine Receptor From *Torpedo californica* Bind α-Bungarotoxin and Neurotoxin II *Naja naja oxiana*

957A0848B Moscow BIOORGANICHESKAYA
KHIMIYA in Russian Feb 95 Vol 21 No 2, pp 152-155

[Article by O. Klukas, I.A. Peshenko, I.L. Rodionov, O.V. Telyakova, Yu.N. Utkin, and V.I. Tsetlin, Bioorganic Chemistry Institute imeni M.M. Shemyakin and Yu.A. Ovchinnikov, Russian Academy of Sciences, Moscow, and Pushchino Affiliate, Bioorganic Chemistry Institute imeni M.M. Shemyakin and Yu.A. Ovchinnikov, Russian Academy of Sciences; manuscript received 8 Jul 94; UDC 577.175.82]

[FBIS Abstract] A study examined the interaction of mono-[¹²⁵I]-iodinated α-bungarotoxin and neurotoxin II *Naja naja oxiana* with synthetic peptides corresponding to fragments 186-198 and 183-198 of the α-subunit (α180-200) of the nicotinic acetylcholine receptor from *Torpedo californica*. Synthetic peptides corresponding to the fragment 125-145 from the α-subunit (α122-150) were also used. The peptides were synthesized by the solid-phase method (the Fmoc/tBu strategy) and immobilized on 96-well P.E.T.G. assay plates. After two hours of incubation at room temperature, the toxin was removed, the wells were rinsed with phosphate-buffered saline, the plate was cut into sections, and a Compugamma 1282 gamma-counter (LKB, Sweden) was used to determine the amount of bound radioactive toxin. The Acn groups on Cys residues did not prevent the peptides from binding the two toxins. Both toxins were found to have quite similar dissociation constants upon interaction with the peptides α186-198 and α183-198, whereas the effectiveness of the interaction of neurotoxin II with the peptide α125-145 was nearly an order of magnitude higher than that of α-bungarotoxin. It was noted that the presence of an acetamidomethyl group on the Cys residues did not result in a loss of toxin-binding activity in the study peptides. It was therefore concluded that the disulfide bond in the peptides is not absolutely necessary for binding. The studies thus indicated the presence of different neurotoxin-binding segments in the α-subunit of the acetylcholine receptor and confirmed the currently accepted model of multisite neurotoxin-receptor interaction. Figures 2, table 1; references 22: 1 Russian, 21 Western.

New Fungicidal Agent of Iturin Group Prepared From Marine Isolate of *Bacillus subtilis*. Isolation, Physicochemical and Biochemical Properties, Identification

957A0776A Moscow ANTIBIOTIKI I
KHIMOTERAPIYA in Russian Feb 95 Vol 40 No 2,
(manuscript received 14 Oct 94) pp 19-21

[Article by G. K. Oleynikova, L. S. Shevchenko, T. A. Kuznetsova and V. V. Mikhaylov, Pacific Ocean Institute of Bioorganic Chemistry, Far Eastern Department, Russian Academy of Sciences, Vladivostok; UDC 577.182.48:579.852.11:615.282]

[FBIS Abstract] Strain KMM 457 of *Bacillus subtilis* was isolated from a frozen sample of the soft coral *Sarcophyton* sp. The samples were collected in 1989 in the South China Sea near the shores of Vietnam on an expedition aboard the research ship Akademik Oparin. Metabolites of the isolate were studied and it was found to yield a number of physiologically active components. One of them designated OGA exhibited fungicidal activity. New laboratory studies reveal that the isolated compounds are homologous and stereoisomer lipopeptides. After partial acid hydrolysis of OGA, which destroys the carbamide bonds between α amino acids, the hydrolysate was found to include aspartic acid, proline, threonine, serine, tyrosine and dipeptide, containing glutamic acid and β amino acid. A comparison with already identified antibiotics of the iturin group confirms that it is a new representative of this group. It is active against a wide range of fungi, such as *Candida albicans* and *Penicillium* sp., but is not effective against gram-positive and gram-negative bacteria. Iturin-related information, drawn upon in this study, was presented by F. Besson, et al., J. ANTIBIOT., Vol XXIX, pp 1043-1049, 1976; Vol XXXI, pp 284-288, 1978, as well as by F. Peypoux, et al. in the same journal (Vol XXXVII, pp 1600-1604, 1984; Vol XXXIX, pp 636-641, 1986. Figure 1; references: 8 Western.

Laboratory Control of Efficacy of Chemotherapy in Melioidosis

957A0776B Moscow ANTIBIOTIKI I
KHIMOTERAPIYA in Russian Feb 95 Vol 40 No 2,
(manuscript received 15 Dec 94) pp 41-45

[Article by V. P. Batmanov, V. I. Ilyukhin and Yu. V. Antonov, Volgograd Anti plague Scientific Research Institute; UDC 615.28:616.98:616-092.4]

[FBIS Abstract] Despite the availability of a number of drugs effective against the causative agent of melioidosis (*P. pseudomallei*), the outcome of the disease is very unpredictable due to the appearance of recidiva-

tion soon or even quite long after treatment, suggesting the need for defining laboratory criteria for gauging the degree of the cure. The following indices were considered: external appearance of animal, change in body weight and temperature, leukocytic blood formula, study of sera in CFT and PHAR reactions, allergotest and isolation of bacterial and L-forms of the causative agent in their dynamics and after the course of treatment. Guinea pigs and albino white rats were used in the experiments. Treatment with several standard drugs began 1 or 2 days after infection and continued for 15, 30 or 40 days. An unquestionable role of persistence of the melioidosis agent in the form of L-variants was found with development of the delayed type of hypersensitivity in the relapses of the disease. Serological reactions such as CFT and PHAR were shown to be of diagnostic value, but it was by far lower than in the allergotest. No correlation was found between the antibody titers in the tested sera and the isolation of the bacterial or L-variants of the melioidosis agent. The criteria indicative of recovery from melioidosis were: stable normalization of patient temperature, positive course of body weight changes, negative tests for the type and morphologically changed forms of the melioidosis agent and no allergic reactions. References 11: 4 Russian, 7 Western.

Site-Directed Cleavage of 16S rRNA Molecules at a Single Internucleotide Bond

957A0735A Moscow BIOKHIMIYA in Russian Feb 95 Vol 60 No 2, (manuscript received 5 Jul 94; after revision 6 Sep 94) pp 297-307

[Article by S. L. Bogdanova, A. I. Degtyarev, P. V. Baranov, S. S. Dokudovskaya, I. N. Lavrik, O. A. Dontsova, T. S. Oretskaya, N. F. Krynetskaya, Z. A. Shabarova, A. A. Bogdanov, Chemistry Department, Lomonosov Moscow State University; UDC 577.123]

[FBIS Abstract] This paper studies the cleaving of 16S ribosomal RNA (rRNA) of *E. coli* using "hammerhead" type ribozymes, as well as RNAase H in the presence of "chimeric" oligodeoxyribonucleotides (containing 2'-deoxy-F-thymidine residues). In both cases conditions are found which make it possible to cleave extended rRNA molecules with complex secondary and tertiary structure at a single internucleotide bond, forming fragments with homogeneous ends. The use of ribozymes is limited by inaccessibility of some sites, cost, and difficulty of the procedure. A figure shows the structure of the ribozymes used to hydrolize 16S rRNA. The structure of the chimeric oligonucleotide is described. Modified ribose residues are very promising in cleaving ribosomal RNA at a single site. Figures 6; references 18 (Western).

**On the Stability of the Dinitrosyl Iron Complex
With Cysteine as a Candidate for
Endothelium-Derived Relaxation Factor**

957A0735B Moscow BIOKHIMIYA in Russian Feb 95
Vol 60 No 2, (manuscript received 5 Jul 94) pp
308-314

[Article by A. F. Vanin, Institute of Chemical
Physics, Russian Academy of Sciences, Moscow; UDC
577.352.5]

[FBIS Abstract] Electron paramagnetic resonance is used to show that the stability of the dinitrosyl iron complex with cysteine (DNIC) $[(\text{cis})_2\text{Fe}(\text{NO})_2]$, which determines its ability to produce NO in an aqueous solution, depends on the redox state of this complex. A change in the amount of cysteine in a DNIC solution has a complex effect on the stability of the DNIC. The complex is most stable in an oxidized diamagnetic state of an electron configuration of iron $d^6(\text{Fe}^{2+})$. Dithionite, cysteine, and GSH restore it to unstable, paramagnetic forms which release NO. The destabilizing action of the thiols depends on their concentration. At lower concentrations (1-5 mM and 20 μ concentrations of DNIC) thiols destabilize DNIC as reducers; at larger concentrations, they act as ligands to stabilize reduced forms of DNIC. Results are contrasted with the results of other authors. The vasodilatory activity of DNIC on blood vessels is said to be due to DNIC in a stable oxidized form. Figures 2; table 1; references 21: 7 Russian, 14 Western.

**Synthesis and Psychotropic Activity of
1-(Triorganylsilyl)-2-(2,2,3,3,4,4,4-Heptafluorbutyl)
Aziridines**

957A0833A Moscow
KHIMIKO-FARMATSEVTICHESKIY ZHURNAL
in Russian Mar 95 Vol 29 No 3, (manuscript received
10 Aug 94) pp 31-32

[Article by Ye. V. Bakhareva, M. G. Voronkov, P. V. Arbuzov, R. G. Mirskov, V. I. Rakhlin and S. B. Seredenin, Irkutsk Organic Chemistry Institute, Siberian Department, Russian Academy of Sciences; UDC 547.85:615.214]

[FBIS Abstract] Until now information on the psychotropic activity of aziridine has been very limited. A number of new aziridine-based psychotropic agents was therefore investigated: 1-(triorganylsilyl)-2-(2,2,3,3,4,4,4-heptafluorbutyl) aziridine and 3 of its N-silylated derivatives (designated compounds I-IV). These compounds were produced by an original photoinduction method. The reaction transpires during UV irradiation of an equimolar mixture of reagents and leads to end products with quite good yields. They were tested on mice and rats, being administered 30 minutes be-

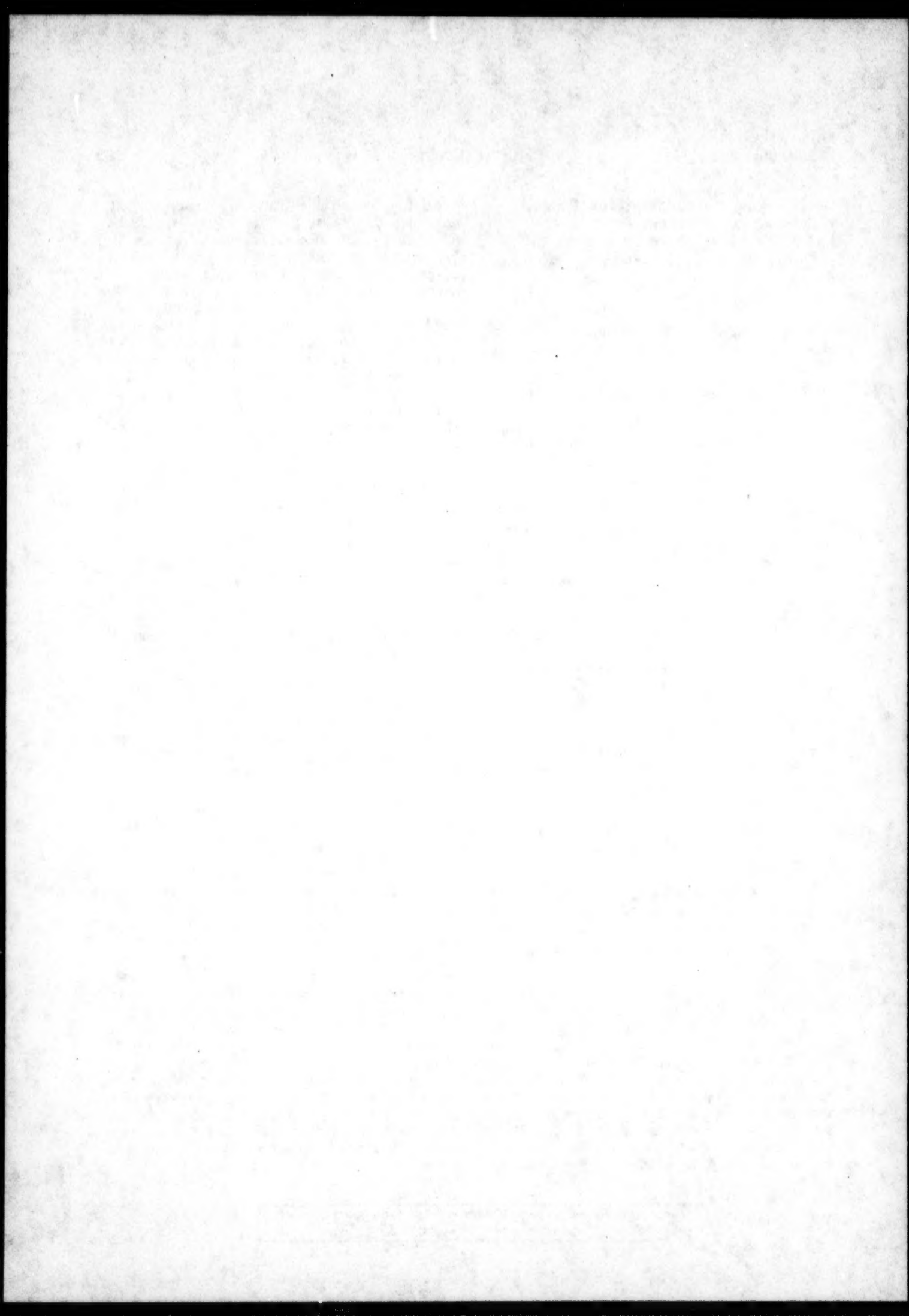
fore testing. Data on the toxicity and antispastic activity of compounds I-IV are given in a table. Among the other testing results are the following. Compounds III-IV exert a distinct antispastic effect. The influence of compounds I-IV on the coordination of movements and muscle tone in doses 1-50 mg/kg was poorly expressed. With an increase in the dose to 100 mg/kg compounds I and II worsen the coordination of movements, as indicated by the appearance of muscle relaxation. Since compound IV has a high pharmacologic activity, its sedative and anxiety-relieving effects were studied. In doses 1 and 10 mg/kg in an open field test its effect on rats was insignificant, indicating absence of a sedative effect, but a conflicting situation test revealed a tranquilizing effect. References: 7 Russian.

**Production of Finely Dispersed Pharmaceutical
Powders by Jet Pulverization and Control of Their
Technological Parameters**

957A0833B Moscow
KHIMIKO-FARMATSEVTICHESKIY ZHURNAL
in Russian Mar 95 Vol 29 No 3, (manuscript received
17 Nov 93) pp 53-55

[Article by M. L. Yezerskiy and A. Ye. Dobrotvorskiy, AO Biotehnologiya; UDC 615.2/3:615.453.2].012]

[FBIS Abstract] Finely dispersed particles measuring $5\mu\text{m}$ are used in the preparation of many pharmaceutical preparations, including inhalants. One effective pulverization tool, a jet mill, was proposed by M. L. Yezerskiy, et al. in KHIM.-FARM. ZHURN., Vol 6, No 10, pp 52-54, 1972. The efficacy of this method is illustrated in the example of sodium benzoate, processed using an S-1266-00 compressed nitrogen jet mill. The mill operating mode is regulated by changing the pressure of the working gas at the mill chamber input, as is the rate of feeding of the substance to be pulverized. Microscopic photographs (400 \times) of the initial and pulverized substance are shown. Pulverization was in two extreme modes. The initial sodium benzoate consisted of elongated nonisometric particles. Upon pulverization the particles became close to isometric. However, quality control requires that microscopic examination be supplemented by mathematical calculations for ascertaining correspondence of the product parameters to technical specifications (such as degree of dispersion). Formulas for this purpose are cited and used in illustrating the results for the tested sample. Studies also were made of other parameters, such as volume density and cohesiveness, which exhibited a distinct correlation with degree of dispersion and other characteristics, including external specific surface and compacting properties. The proportioning error, depending on the pulverization mode, varies from 8 to 10 percent. Figures 3; references: 5 Russian.



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